

SIGNAL SECTION ADVANCE NOTICE

ASSOCIATION OF AMERICAN RAILROADS

PUBLISHED BY THE SIGNAL SECTION, A.A.R., 59 EAST VAN BUREN STREET, CHICAGO 5, ILL.
SUBSCRIPTION: \$3 AND \$6 PER ANNUM.

Vol. XLVII

No. 1

REPORTS

to be presented at the
Fifty-second Annual Meeting
NEW YORK, N. Y.
September 18, 19 and 20, 1950

RULES OF ORDER

RESULT OF 1949 LETTER BALLOT

CONTENTS

	Page
COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING	5
Disposition of 1949 Letter Ballot Subject.....	6
Costs Involved in Stopping Trains—Progress Report.....	6
Economics of Railway Signaling During World War II.....	7
Economics of Traffic Control System Replacing Manual Block and Train Order Operation.....	15
Economics of Signal Indication Operation on Light Traffic Single-Track Lines.....	16
Economics of Automatic, Auto-Manual and Manual-Controlled Highway Crossing Protection Devices.....	20
Economics of Car Retarders at Two Important Coal Traffic Terminals.....	22
Economics of Retirement of Second Track and Siding and Converting Second Track to Siding in Centralized Traffic Control Territory.....	28
Formula for Estimating Train Miles Saved Due to Increased Tonnage with Centralized Traffic Control.....	39
Effect of Various Classes of Track on Taxation.....	42
Train Hour Value.....	44
Economics of Communication Between Front and Rear End and Between Engines, Trains and Fixed Points.....	52
Installations of Train Operation by Signal Indication Without Train Orders, in the United States January 1, 1949.....	56
Train Communication Systems—Line of Road Installations in Service January 1, 1949.....	57
Interlockings in the United States, January 1, 1949.....	58
Railroad-Highway Grade Crossings—Number of Crossings Equipped, Types of Protection, and Number of Unprotected Crossings in the United States, December 31, 1947 and 1948.....	59
Spring Switches in Service in the United States as of January 1, 1949.....	60
Track and Roadway Maintenance Expenses—Per Equated Track Mile.....	61
Operating Advantages of Interlocking Installations.....	64
Economics of Sidings in Centralized Traffic Control Territory as Effected by Siding Usage, Siding Length and Size of Turnout.....	66
Economics of Route Locking With Sectional Release on Power-Operated Switches in Centralized Traffic Control Territory.....	71
Economics of "Off Track" Equipment.....	73
COMMITTEE II—INTERLOCKING	74
Disposition of 1949 Letter Ballot Subjects.....	74
Specification 152-50—Electro-Pneumatic Switch Operating Mechanism.....	76
Specification 101-50—Electric Motor Switch Operating Mechanism.....	83
A.A.R. Sig. Sec. 1457C—Load Requirement for Power-Operated Switch Mechanism.....	91, 92
COMMITTEE III—SIGNAL SHOP PRACTICE	93
Formula for Determining Cost of Repairing Signal Material.....	93
Requisites for Salvaging Or Repairing of Signal Material.....	96
Requisites for Containers for Shipping Relays and Similar Apparatus.....	97
COMMITTEE IV—AUTOMATIC BLOCK SIGNALING	98
Disposition of 1949 Letter Ballot Subjects.....	99
Specification 135-50—Track Circuit Bonding.....	101
Specification 151-50—Plug Type Rail Bonds and Track Circuit Connectors.....	104
A.A.R. Sig. Sec. 1047B—Welded Type Rail Head Bonds and Track Circuit Connectors.....	111, 112
A.A.R. Sig. Sec. 1631E—Single Conductor Plug Type Rail Bonds and Track Circuit Connectors.....	111, 113
A.A.R. Sig. Sec. 1632E—Duplex Conductor Plug Type Rail Bonds and Track Circuit Connectors.....	111, 114
Requisites for Track Welding or Heat Treating in Track Circuit Territory.....	115
Requisites for Minimizing the Effect of Foreign Current on Direct Current Track Circuits.....	117
Specification 199-50—Electric Motor Mechanism and Gate Arm for Highway Grade Crossing Signal.....	118
Devices for Sanding of Rail, or Equivalent, Which Will Reduce Track Circuit Shunt Failures Due to Sand.....	120
Specification 160-50—Capacitor for Power Factor Improvement.....	129
Specification 78-50—Alternating Current Induction Type Relay.....	134
Protection Against Lightning.....	142
Specification 162-50—Color Position Light Signal.....	145
Specification 157-50—Color Light Signal, Searchlight Type.....	151
Development of Proposed Inductive Coordination Measures Involving Railroad Power Lines and Power Equipment—Cooperative Report.....	152
Lightning Arresters—A.S.A. Project C62—Cooperative Report.....	153
COMMITTEE V—CONTRACTS AND INSTRUCTIONS	154
Disposition of 1949 Letter Ballot Subjects.....	155
Definitions for Technical Terms Used in Signaling.....	155
Instructions for Non-Coated Direct Current Track Circuits.....	157
A.A.R. Sig. Sec. 1662D—Graphical Symbols—Tracks and Highway Crossings.....	160, 161
A.A.R. Sig. Sec. 1673E—Graphical Symbols—Relays.....	160, 162
A.A.R. Sig. Sec. 1674F (Three Sheets)—Graphical Symbols—Relay Contacts.....	160, 163-165
A.A.R. Sig. Sec. 1680C (Two Sheets)—Graphical Symbols—Circuit Appurtenances.....	160, 166-167

(Concluded on inside back cover)

ASSOCIATION OF AMERICAN RAILROADS
SIGNAL SECTION

COMMITTEE REPORTS

1949 Fiscal Year
(September 14, 1949—September 20, 1950)

Fifty-Second Annual Meeting
Hotel Statler
New York, N. Y.
September 18, 19 and 20, 1950

ASSOCIATION OF AMERICAN RAILROADS

SIGNAL SECTION

The Committee of Direction suggests that papers of interest to the Signal Section be forwarded to the Secretary. They will be submitted to the proper committee for approval and printing in the literature.

ASSOCIATION OF AMERICAN RAILROADS

OPERATIONS AND MAINTENANCE DEPARTMENT

ENGINEERING DIVISION

SIGNAL SECTION

Office of the Secretary, 59 East Van Buren Street, Chicago 5, Ill.

J. H. AYDELOTT
VICE-PRESIDENT
Operations and Maintenance
Department

Officers of Section
W. S. STORMS, Chairman
D. W. FULLER, First Vice-Chairman
E. S. TAYLOR, Second Vice-Chairman
R. H. C. BALLIET, Secretary

COMMITTEE OF DIRECTION

(January 1, 1950 to December 31, 1950)

Officers and Latest Past Chairman

W. S. Storms, Chairman, Erie R. R.
D. W. Fuller, First Vice-Chairman, Atchison, Topeka & Santa Fe Ry.
E. S. Taylor, Second Vice-Chairman, Canadian Pacific Ry.
L. S. Werthmuller, Missouri Pacific Lines. (Past Chairman)

Territorial Representatives

E. N. Fox, Boston & Maine R. R. and Maine Central R. R. (New England)
H. B. Garrett, Southern Pacific Co. (West)
A. S. Haigh, New York Central System (East)
L. C. Walters, Southern Ry. System (South)
W. W. Welsh, Baltimore & Ohio R. R. (East)
T. W. Hays, Union Pacific R. R. (West)
J. S. Webb, Atlantic Coast Line R. R. (East)
B. W. Molis, Denver & Rio Grande Western R. R. (West)

ORGANIZATION

Standing Committees

- I. ECONOMICS OF RAILWAY SIGNALING.
A. M. Crawford, Pennsylvania R. R., Chairman.
- II. INTERLOCKING.
H. A. Hudson, Southern Ry., Chairman.
- III. SIGNAL SHOP PRACTICE.
E. S. Taylor, Can. Pac. Ry. System, Chairman.
- IV. AUTOMATIC BLOCK SIGNALING.
E. N. Fox, B. & M. R. R. and Me. Cent. R. R., Chairman.
- V. CONTRACTS AND INSTRUCTIONS.
C. D. Cronk, N. Y. C. System, Chairman.
- VI. DESIGNS.
J. C. Lummis, Chesapeake & Ohio Ry. System, Chairman.
- VII. MATERIALS RESEARCH.
E. A. Burgin, Chesapeake & Ohio Ry. System, Chairman.
- VIII. HIGHWAY GRADE CROSSING PROTECTION.
W. H. Stilwell, Louisville & Nashville R. R., Chairman.
- IX. OVERHEAD AND UNDERGROUND LINES.
G. C. Felton, Pennsylvania R. R., Chairman.
- X. SIGNALING PRACTICE.
G. K. Thomas, A. T. & S. F. Ry., Chairman.
- XI. ELECTRONICS.
A. B. Armistead, Norfolk & Western Ry., Chairman.
- XII. CIRCUIT DESIGN.
W. W. Welsh, Baltimore & Ohio R. R., Chairman.

COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING

Personnel

A. M. Crawford, Chairman

T. W. Hays, Vice-Chairman

A. B. Armistead	R. E. Taylor
A. L. Essman	F. A. Tegeler, Jr.
H. B. Garrett	L. C. Walters
W. N. Hartman	J. S. Webb
H. A. Hudson	L. S. Werthmuller
J. F. McConahay	B. T. Anderson*
B. W. Molis	J. H. Dunn*
L. B. Porter	S. W. Freeman*
W. F. Price	S. E. Gillespie*
R. F. Raughley	C. A. James*
E. W. Reich	E. E. Kimball*
B. J. Schwendt	R. M. Phinney*
E. B. Smith	C. B. Mattingly*
W. S. Storms	C. W. Sooby*

E. A. Warner*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on the economics of railway signaling.

The Committee submits for consideration, reports on the following subjects**:

3. Costs involved in stopping trains—progress report.

Economics of railway signaling during World War II.

Economics of traffic control system replacing manual block and train order operation between Aberdeen and Mobridge, S. Dak., on the Chicago, Milwaukee, St. Paul & Pacific R.R.

Economics of signal indication operation on light traffic single-track lines.

Economics of automatic, auto-manual and manual-controlled highway crossing protection devices.

Economics of car retarders at two important coal traffic terminals on the Chesapeake & Ohio Ry.

Economics of retirement of second track and siding and converting second track to siding in centralized traffic control territory on the St. Louis-San Francisco Ry. between Newburg and Lebanon, Mo.

Formula for estimating train miles saved due to increased tonnage with centralized traffic control.

Effect of various classes of track on taxation.

Train hour value.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Economics of communication between front and rear end and between engines, trains and fixed points.

Installations of train operation by signal indication without train orders, in the United States, January 1, 1949.

Train communication systems—line of road installations in service, January 1, 1949.

Interlockings in the United States, January 1, 1949.

Railroad-highway grade crossings—number of crossings equipped, types of protection and number of unprotected crossings in the United States, December 31, 1947 and 1948.

Spring switches in service in the United States as of January 1, 1949.

Track and roadway maintenance expenses—per equated track mile.

Operating advantages of interlocking installations at Linden, Roachdale and Gosport Junction, Ind., on the Chicago, Indianapolis & Louisville Ry.

Economics of sidings in centralized traffic control territory as effected by siding usage, siding length and size of turnout.

Economics of route locking with sectional release on power-operated switches in centralized traffic control territory on the Denver & Rio Grande Western R.R.

Economics of "off track" equipment.

Disposition of 1949 Letter Ballot Subject

The following subject presented by Committee I at the 1949 Annual Meeting was submitted to letter ballot and officially approved:

Form 24—Economic Statement—Now in Manual Part 29.

PROGRESS REPORT

COSTS INVOLVED IN STOPPING TRAINS

The Committee reports progress in the matter of developing the cost of stopping freight trains hauled by Diesel-electric locomotives. The cost of stopping freight trains hauled by steam locomotives has been concluded.*

Report in the matter of the cost of stopping freight trains hauled by Diesel-electric locomotives has been completed; however, time has not permitted its being checked and placed in final form. It is expected it will be available for printing and submission at the 1951 Annual Meeting.

The Committee desires to acquaint the Section with the fact that the forthcoming report has been prepared by graduate students and faculty of the University of Illinois working under the direction of H. J. Schrader, Research Professor of Theoretical and Applied Mechanics, in cooperation with Committee I.

Action Recommended

Acceptance as information.

* A.A.R. Signal Section 1946 Proceedings, Vol. XLIV, pp. 7-A and 326-A.

ECONOMICS OF RAILWAY SIGNALING
DURING WORLD WAR II*History.*

The story of the part played by signaling in the remarkable performance of our railroads during World War II, will probably never be completely known nor told. If it were possible to piece together the individual accomplishments in the maintenance and expansion of signal systems of the various railroads, the collective accomplishment of the signal departments acting through the Signal Section, A.A.R., and the contributions of the signal supply industry, an impressive record of service in the war emergency would undoubtedly be revealed. The fact is that signal departments, under very difficult manpower and material conditions, were able to keep their existing signaling functioning in the face of unprecedented traffic demands and were able to expand the signal plant very substantially to further improve train operation.

The problem of the signal officers in war time was one of economics—not the dollar economics of peace time, but the even more vital economics of securing the most effective utilization of restricted quantities of critical materials and manpower as a contribution towards securing the greatest amount of work from existing railway plant and equipment. The demand for expansion of signal systems to provide for safer and more expeditious movement of war traffic had to be balanced against the need for maintaining the existing plant in safe working order.

The problem of the signal officer was to divert as much material and manpower, from maintenance to new construction, as was safe. Fortunately, a sufficient margin of safety was inherent in the existing signal systems to permit deferment of much maintenance work, which would normally have been done, in favor of important new constructions. Fortunately, also, these compromises with established standards of maintenance did not result in any serious consequences, although they undoubtedly caused some concern and redoubled effort on the part of maintenance officers and employees.

Almost without exception, railway signal departments were called upon to perform a bigger job than they had been doing with the loss of key personnel to the armed forces. This, of course, meant that the forces remaining were called upon for the exercise of considerable ingenuity and a great deal of hard work. The case history of practically any signal department selected at random from the list of American railroads would furnish an example in point.

Signal departments were first of all required to keep the facilities under their jurisdiction in safe working order. Maintenance was a "must," but maintenance programs had to be examined carefully so that expenditures of material and manpower, capable of safely being deferred, would be postponed. Obviously, in many cases, this involved a curtailment of established maintenance programs, which were normally economically sound, and imposed an added burden when these programs were reinstituted because the expedients taken, in connection with the provision of minimum maintenance, were often of a temporary nature.

Difficult decisions were the order of the day for the signal engineer who had to determine whether it was better to submit to the pressure to keep maintenance expenditures of material at an abnormally low level or to fight what might be a losing battle for higher standards. The signal engineer with a relatively low average age of signaling on his property had a comparatively easy problem on this score, but the signal engineer with large mileage of older signaling was forced to make decisions contrary to his best judgment.

The big demand on signal departments was for expansion of signal systems and the installation of new signal systems for the improvement of railway operating efficiency. Constant pressure was brought to bear for these new installations because they represented the most effective means of increasing track capacity with relatively small expenditure of basic raw materials vital to the prosecution of the war. The duty of the signal engineer was not simply the placing of these installations in service after someone else told him where they were to be placed; in most cases, he had to make studies of at least several projects to determine which was capable of producing the quickest and greatest war time transportation advantage. He then had duties in connection with securing authorization of the project by management and governmental authority, after which his duties in connection with the project did not lessen in difficulty.

Once the necessary authorizations were secured, the problems of coordinating deliveries and construction schedules became major headaches. With a multiplicity of these projects in various stages of study, preparation for authorization or construction, plus some very real problems of material procurement for maintenance, the signal engineer was busily employed during the war years.

Signal construction during war years.

Some idea of the amount of construction accomplished during these years is gleaned from the statistics of new signaling placed in service from 1940 to 1948.* Table I shows the Comparison of Annual Signaling Construction since 1940 which includes the war years. A large part of the construction completed during 1946 and some of the construction of 1947 represented projects under way, authorized or under study during the last year of the war. The momentum gained particularly in centralized traffic control has been maintained since the war partly as a result of the more widespread appreciation of the potentialities of this system of signaling as evidenced by its wartime performance.

Table I indicates that, with the single exception of highway crossing protective units, signal construction proceeded at an increasing rate during the war years. All of this construction was either specifically authorized or conducted under authorized use of maintenance-of-way allocations. Perhaps a more revealing picture of the magnitude of the task confronting the signal departments may be obtained from the tabulation of Annual Maintenance, Operation, and Investment Charges for Railway Signals and Interlockings on Class I Railroads, U.S.A., 1940-1948, shown in Table II.

* *Railway Signaling and Communications*, January 1949, p. 29.

TABLE I
Comparison of Annual Signaling Construction 1940-1948
Signal Units Placed in Service in U.S.A. and Canada

	1940	1941	1942	1943	1944	1945	1946	1947	1948
Automatic block signals.....	1,017	1,407	1,421	1,690	1,539	2,350	3,078	2,269	1,711
Cab signaling.....									514
Interlockings:									
Signals and switches									
At new plants.....	1,024	518	785	1,498	851	910	1,529	857	1,074
At rebuilt plants.....	734	693	554	760	687	940	993	408	665
At automatic plants.....	125	80	78	55	62	88	132	83	80
Spring switches:									
Spring buffer mechanisms.....	294	275	284	448	382	764	554	356	264
Mechanical facing point locks.....	97	159	126	88	115	341	248	107	107
Signals at spring switches.....	336	354	384	498	553	991	707	491	516
Centralized traffic control:									
Power switch machines.....	121	190	263	463	596	633	453	538	565
Semi-automatic signals.....	375	675	1,030	1,775	2,141	2,217	1,385	1,810	1,725
Intermediate signals in C.T.C. territory.....								853	738
Classification yards (freight):									
Car retarders.....	11		51		25	14	18	23	100
Power switch machines.....	19		108		52	57	73	27	192
Highway crossing protection:									
Protective units.....	3,006	2,615	1,297	477	643	1,089	2,214	2,852	3,621
Total units.....	7,159	6,996	6,381	7,752	7,646	10,394	11,384	10,674	11,872

Sept. 1950]

Signal Section, A.A.R.
Com. I—Economics of Ry. Signaling

TABLE II

Annual Maintenance, Operation, and Investment Charges for Railway Signals and Interlockings on Class I Railroads, U.S.A.—1940-1948

Year	Maintenance of signals and interlockings Account 249	Operation of signals and interlockings Account 404	Investment in road and equipment Account 27	Total
*1940	\$26,237,051	\$20,525,620	\$ 3,782,917	\$ 50,545,588
*1941	30,894,828	21,473,350	4,594,277	56,962,455
*1942	35,773,504	24,073,283	5,889,184	65,735,971
*1943	37,578,916	25,776,787	10,046,939	73,402,642
*1944	43,109,701	28,636,617	13,673,043	85,419,361
*1945	44,609,126	28,248,314	28,727,260	101,584,700
*1946	47,269,216	32,190,887	20,766,037	100,226,140
*1947	49,447,167	34,106,012	29,184,457	112,737,636
1948	56,884,525	37,605,024	32,365,205	126,854,754

While Table II is based on dollar values, and one which must be considered in the light of changing prices and costs, it shows the maintenance and construction activity during and following the war years. The increase in Investment Account 27 from less than \$4 million in 1940 to nearly \$29 million in 1945 shows the trend of expansion in signaling.

Restriction of materials available to the signal industry began about a year before the entry of the United States into World War II, late in 1941. The production of signal apparatus and the other elements entering into railway signal systems requires substantial quantities of the same kinds of materials used for armament production. It was not until after our entry into the war on an active basis that there began to be a fuller appreciation of the role of rail transportation and then the potentialities of signal systems began to receive some recognition.

The producers of railway signaling equipment were deemed essential war producers through their contribution to the transportation systems and transportation requirements of the Armed Services. Most of them also engaged in production of large quantities of direct armament items, which they were especially well equipped to produce, in addition to supplying record quantities of signal materials. Under the early methods of priorities, material procurement was especially difficult for both the railroads and the signal producers. At no time during the war was it especially easy because signal systems use the most critical types of raw materials as well as the production facilities being among the most desirable for direct military items.

It was possible, in many individual cases, to demonstrate that signal facilities were capable of producing proportionately a very high return to the war economy on the material and production facilities devoted to their construction. It was necessary, however, to prove each case individually, partly because there generally were more potential users for the limited material allocations available than there was material or production facilities to allocate.

* A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, p. 50.

Demands on the signal industry during the war were heavy not only because of the domestic requirements, but also because of the filling of some requirements of countries allied with the United States in the war.

The problem of securing allocations of basic material was great, but that of securing the output of fabricators, such as wire and cable mills and that of battery manufacturers was one involving constant attention. Output of these producers was under very rigid schedule and in great demand by the armed forces and practically all war-essential industry, including railroad transportation.

Material procurement was not the only problem of railway signal officers. The problem of retention of manpower and where possible the employment of additional help demanded constant attention. Much attention was paid to the improvement of construction methods and considerable reliance on methods which reduced the amount of field labor. Use of factory wiring or wiring performed at a centralized location was resorted to in order to expedite construction projects.

Conservation of materials and personnel.

Signaling made important contributions to conservation of critical war materials and manpower by providing an economically attractive utilization of those resources and by its contributions to a better transportation job. It also made important contributions by revision of practices and standards within the signal profession and industry, in conformity with the necessity for exercise of every practical means for securing maximum utilization of critical materials.

The signal industry made it possible to conserve large quantities of steel, copper, and other metals, as well as production facilities, by providing systems for improving utilization of tracks, locomotives and cars. Without centralized traffic control, it would not have been possible to improve the capacity of certain critical railway lines unless very great mileages of additional main tracks were constructed. The steel to make these track additions was simply not available without depriving other lines of badly needed rail and other track material. Centralized traffic control was the only alternative and its installation not only directly improved the line on which it was installed, but also other lines which might have been deprived of necessary rail if the decision had been to add additional track.

The improved operation of trains by elimination of delays made it possible for fewer locomotives to perform the transportation task in the equipped area. This meant that the released locomotives could be assigned to other areas, or that fewer locomotives were required to be built for domestic use. The signal installation which was capable of causing locomotive pools to be reduced was in effect saving not only the critical material involved in construction of an equivalent number of locomotives but the very critical production facilities involved. The expedition of car movement brought about by centralized traffic control and other signaling improvements was the equivalent of adding many thousands of cars to the nation's supply of this equipment. Probably no war-time signal project saved less than its equivalent in critical material required to produce the same transportation advantage by other means. Most

of them saved a great many times their critical material and manpower cost by reducing the need for locomotives and cars as well as other fixed facilities.

The saving in critical operating manpower on railroads by elimination of train order offices was also an important contribution of the signal installations placed in service. Centralized traffic control not only made it possible to reassign operators from positions eliminated within the territory, but made it unnecessary to establish other offices which would have been required under the previous method of directing trains. The fact that centralized traffic control installations opened up a reservoir of trained personnel which it was possible to assign for improvement of performance on other parts of the railroad was very important at a time when dispatchers and experienced operators were very difficult to obtain. There were some cases where centralized traffic control made it possible for experienced dispatchers who had reached normal retirement age to continue in service, because of the less exacting nature of the work. These men could not have withstood the strain of increased traffic under the former system.

Signaling, particularly centralized traffic control, therefore, did more than improve the lines to which it was applied during war time. It released material for application to other essential use and it released manpower desperately needed elsewhere.

Conservation and substitution practices in the field of railway signaling resulted from considerable study on the part of the railroads both individually and collectively through the Signal Section, and by the signal manufacturers. Because of this, it was not necessary for the War Production Board to issue special conservation orders affecting railway signaling, although manufacturers were subject to many restrictive conservation orders applicable to all industry which was at times the cause of production restrictions.

In the approach to material conservation in the signal industry, the railroads and the manufacturers of signal equipment directed their efforts to the greatest possible saving of critical items within the bounds of providing safe signaling. The most important saving from the standpoint of quantities of material probably resulted from operation under the Emergency Signal Section Specifications and from developments and changes in the design of signal systems, chief among which was the multiple use of centralized traffic control line wires. Other important saving was brought about by re-design and substitutions, where practicable, in the signal manufacturing industry. Among the principal sources of critical material saving* were:

Copper.

1. Thirty-seven to 60 per cent saving in poundage of copper due to reducing conductor size.
2. Saving due to substitution of iron wire for copper where conductivity was not a factor.
3. Saving of 60 to 70 per cent of poundage of copper due to the use of copper-covered steel wire instead of solid copper.
4. Use of rail head in lieu of web type bonds.
5. Salvage of exhausted primary battery elements.
6. Substitutions and re-design on the part of manufacturers, resulting in saving copper and copper alloys.

* A.A.R. Signal Section 1941 Proceedings, Vol. XXXIX, pp. 225-235.

Nickel.

This very highly critical metal which is used in the manufacture of signal apparatus largely as an electroplating material was under very severe restriction. In compliance with orders restricting its use to those applications where no satisfactory substitution could be made without adversely affecting functioning of the device, signal manufacturers were able to reduce their nickel requirements.

Aluminum.

This metal which had some important but not extensive use in the signal field was in particularly limited supply in the early period of the war. Substitution of less critical metals and other materials resulted in saving this metal.

Tin.

This metal was used in signaling extensively for plating iron and steel for protection against corrosion and in the making of brass castings. Because of compliance with conservation orders the industry made a saving in their requirements.

Cadmium.

This metal was in extremely limited supply and it was necessary to use substitute plating materials for practically every application. As a result of compliance with orders affecting its use, the signal industry reduced its requirements to an almost negligible amount required for a few special applications.

Rubber.

Reduction in gage of wire and thickness of insulation brought about a substantial reduction in the rubber requirements as did the use of synthetic insulation not requiring rubber.

*Effects of the war on railway signaling.**

The foregoing outlines some of the ways in which signaling made its contributions to the war effort by improving railway transportation, by bringing about more effective use of facilities and manpower and by making changes in signal practice for the purpose of conservation of critical materials. It is fitting that some appraisal be made of the effect of the war on post-war signaling.

First of all there seems to be no doubt that the importance of signaling, as demonstrated by its performance during the war years, has resulted in a

* "Railroad Signals Go to War"—Joseph B. Eastman, Director of Defense Transportation.

"Manufacturer's War Problems"—R. H. Weber, Chairman, Signal Appliance Association.

"Signaling as Considered by War Production Board"—Eugene Moore, W.P.B.

"Utilization of Signaling in War" and "Signal Section Work in War"—J. J. Corcoran, Chairman, Signal Section.

sharpened appreciation of its value in peace time. As a result of installations of centralized traffic control made during the war, progress in this form of signaling has probably been greater than it would otherwise have been. Railroads with little or no centralized traffic control signaling at the beginning of the war are now among those with the greatest mileage in service and they are now expanding their centralized traffic control mileage.

The conservation practices of the war period have not been entirely abandoned. The work of the Signal Section in determining means by which signaling could save material have also, in some cases, shown the way to save money, which is important even though the need for saving particular kinds of metal no longer appears vital. This cooperative work in development and adherence to conservation principles has reacted favorably to the signal engineering profession.

The engineering practices which led to a type of engineering thinking, geared to reducing an installation to its barest essentials, has led to greater coordination between layout of signal systems to actual operating requirements and a disposition to consider minimum rather than maximum requirements as the basis for an installation. This has required the economic justification of centralized traffic control on lines where it probably would not have been previously considered. In short, the critical attitudes toward making signaling fit the needs of traffic during the war have carried on into making signal departments more and more operation conscious, and the signal engineer a better operating man.

Railway signaling did not stand still nor go backwards during the war, but as a whole advanced much more than could have been expected in a period of material and manpower shortage. It is true that some phases of signal development were hampered by the diversion of key personnel to other vital war duties, but it is possible that the absence of these important men from active participation in the industry was at least in part offset by the increased productivity and development of those who remained.

Action Recommended

Acceptance as information.

ECONOMICS OF TRAFFIC CONTROL SYSTEM REPLACING
MANUAL BLOCK AND TRAIN ORDER OPERATION
BETWEEN ABERDEEN AND MOBRIDGE, S. DAK.,
ON THE CHICAGO, MILWAUKEE,
ST. PAUL & PACIFIC R.R.*

The Chicago, Milwaukee, St. Paul & Pacific R.R. in 1946 installed traffic control in lieu of manual block and train order operation on a 98-mile subdivision, between Aberdeen and Mobridge, S. Dak., of its Chicago-Seattle Coast Line.

This section of line crosses rolling prairie, the grade being limited generally to 0.5 per cent eastward and 1.0 per cent westward. The curvature is slight with long sections of tangent. The rail is 112-pound and the siding turnouts are No. 11. Traffic averaged 6 passenger and 7.5 freight trains daily in 1949.

The sidings vary in length from 85 to 155-car capacity and are spaced an average of 7 miles. Except for one spring and three power, all switches are hand-operated.

The control machine, of conventional centralized traffic control design, is located in the train dispatcher's office at Aberdeen. The signals at ends of sidings are controlled; also the dwarf signals governing movements from house tracks to main line. The usual indications and traingraph recorder are provided on the control machine.

Economic Statement

1. Cost of Installation:	
(a) Capital Investment.....	\$390,308
(b) Operating Expenses.....	2,168
(c) Total.....	<u>\$392,476</u>
2. Gross Saving per Annum.....	\$130,996
3. Increased Annual Operating Expenses.....	19,245
4. Net Reduction in Annual Operating Expenses.....	\$111,751
5. Deduction for Interest Charges @ 6% (of 1-a).....	23,418
6. Net Saving per Annum.....	<u>\$ 88,333</u>
7. Annual Return over 6% Interest:	
(a) On Capital Investment (6 ÷ 1-a).....	22.6%
(b) On Total Cost (6 ÷ 1-c).....	22.5%

*A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 144 and 442.

Summary of Advantages

1. Train stops, slow-downs, and delays at meeting points, block stations, train order offices, and terminals have been reduced.
2. The average road time per freight train has been decreased 1 hour 45 minutes, or an average of 1.07 minutes per freight train mile.
3. Reduced the cost of directing train movements.
4. Increased the safety of train operation.

Action Recommended

Acceptance as information.

ECONOMICS OF SIGNAL INDICATION OPERATION
ON LIGHT TRAFFIC SINGLE-TRACK LINES

Signal indication operation by means of centralized traffic control has been provided at many bottleneck locations in medium, heavy and capacity traffic territory. A substantial number of installations have also been made in light traffic territory because of the superior train performance under signal indication operation as compared with methods of operation requiring train orders and conventional block signaling.

The type of signaling economically justified for each traffic designation is dependent upon the local operating and competitive conditions on each railroad. The published records show that centralised traffic control installations have been made on railroads with as few as 12 trains per day, as shown in Table I.

This list of nearly 1,000 track miles does not include all centralized traffic control projects with about 20 trains per day, but only those on which published records are available.

Discussion of traffic designation.

Whether the traffic is considered light, medium, heavy or capacity, is dependent on two factors: (1) number of trains daily, and (2) intervals between trains (distribution of traffic).

A small daily number of trains with movement concentrated in a short period of time, for a few hours may result in congestion equivalent to that of a much larger daily number of trains which are well distributed throughout the 24 hours.

In general, traffic may be classified as follows:

Light traffic—Number of trains so distributed that they can be spaced from siding-to-siding block.

Medium traffic—Number of trains so distributed that signal spacing less than siding-to-siding block is required for expeditious movement of traffic.

Heavy traffic—Number of trains so distributed that signal indication operation without train orders is required for expeditious movement of traffic.

TABLE I

Light Traffic Centralized Traffic Control Installations

No.	Railroad	Location	In service	Road	Miles of Track	Trains per day*	Pub. ref.**
1	Alton.....	S. Joliet—Plaines.....	1934	2.8	2.8	20	198
2	Alton.....	Plainview—Rinker.....	1937	8.3	8.3	21	264
3	B. & O.....	Gilkeson—Wheeling.....	1931	42.5	42.5	20	97
4	B. & O.....	Fairpoint—Maynard.....	1931	5.4	8.3	14	196
5	B. & L. E.†.....	Meadville Jct.—Filer.....	1942	49.9	88.6	24	1943-81
6	C. M. St. P. & P.....	Beloit—Rockton.....	1933	3.1	3.1	18	200
7	C. M. St. P. & P.....	Manilla—Council Bluffs.....	1942	60.0	60.0	12	154
8	C. M. St. P. & P.....	Laredo—Polo.....	1944	51.4	51.4	18	1945-225
9	C. R. I. & P.....	El Reno Jct.—Herington.....	1947	222.8	222.8	20	1948-343
10	Erie.....	Leavittsburg—Pymatuning.....	1941	28.6	28.6	18	1942-189
11	G. M. & O.....	Murphrysboro—N. Cairo.....	1947	58.5	58.5	14	1948-348
12	L. & N.....	Lebanon Jct.—Sinks.....	1945	107.1	107.1	20	1946-521
13	L. & N.....	Henderson—Strawberry.....	1946	137.1	137.1	16	1947-782
14	P. R. R.....	Huntley—Sterling Run.....	1937	4.6	4.6	18	273
15	P. R. R.....	Norwood Hts.—Glen.....	1941	60.7	60.7	18	145
16	P. R. R.....	Hudson—Arlington.....	1940	12.0	12.0	13	76
17	St. L.-S. F.....	Springfield—East Yard.....	1944	41.7	44.9	21	1945-302
18	T. & N. O.....	Alpine—Paisano.....	1930	12.7	12.7	14	203
19	Wabash.....	Lafayette Jct.—State Line.....	1931	37.0	37.0	19	123
Total—12 railroads.....*				946.2	991.0		

* Trains per day is average at date of publication.

** "Pub. ref." refers to page 88 of Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices, or *Railway Signaling* reference.

† Item 5, B. & L. E., refers to a two-track installation.

Capacity traffic—Number of trains of such volume that serious delays to train operation occur with former method of directing train movements and signal indication operation on all tracks may be necessary for expeditious movement of traffic.

The number of trains per day for each of these traffic classifications for single track, with reasonably well-distributed traffic, are estimated as follows:

No. of trains daily	Single Track Traffic designation
20 or less	Light
20-40	Medium
40-60	Heavy
60 and over	Capacity

These traffic designations vary on different railroads during the seasonal peaks each year and especially during emergency operation due to detour train movements and other emergencies.

Comparison of centralized traffic control with other methods of governing train movements.

In each of the 19 centralized traffic control installations listed in Table I the previous methods of directing train movements consisted of train orders with automatic block signals, manual block signals or no block signal system.

Signal indication operation, while higher in first cost in some cases than any alternate block signal system, provided increased safety and facility of train operation with reduced annual operating expenses sufficient to justify the new capital expenditure.

Central traffic control operation permits the use of fewer sidings for meets and passes, requires less track expense for longer sidings at fewer locations, and results in the first cost being kept to a minimum for the required operating facility for which the signaling was designed. In some cases, the cost of centralized traffic control for light traffic may not exceed the cost of an alternate block system designed on the former basis with modern standards of installation on a greater number of sidings.

Centralized traffic control will show economies of operation not possible with other methods of block signaling. The time saving per freight train mile will be higher, the cost of directing train movements will be lower, the train stops saved will be higher due to the use of power in place of hand-operated siding switches. These factors will result in the greater utilization of locomotives and cars with a higher annual saving in operating expenses.

Summary of Economic Advantages of Signal Indication Operation

Among the economic advantages derived from these installations may be mentioned the following:

1. Reduces the number of sidings required for meets and passes by one-third or more.
2. Saves freight train time, train hours, locomotive hours and car days.
3. Reduces the cost of directing train movements.
4. Increases the safety of train operation.

5. Saves train stops and slow-downs.
6. Reduces the number of switches in main track.
7. Reduces annual operating expenses.
8. Increases the capacity of the line.
9. Shows a return on the capital investment varying from 16 to 50 per cent.

The decrease in traffic following the war years, and the use of heavier motive power which have resulted in longer freight trains moving at higher average speeds, have reduced the number of train movements per day on many railroads. At the same time, the cost of train operation and the cost of train stops have increased and have made it important to reduce delays, expedite traffic and reduce operating expenses, even if only a small number of trains are involved. For these reasons, studies of the proper signaling for a particular territory should be made to determine the relative merits of signal indication operation as compared with other signaling systems in light traffic territory.

Advance planning.

The 1948 Proceedings of the American Association of Railroad Superintendents, pp. 24-25, contain the following report on this subject:

"At the present time railroads are installing considerable mileage of automatic block signals, particularly on the lighter traffic lines. While there is no question about the efficiency of centralized traffic control on lines of medium to heavy traffic, we feel that Superintendents are largely responsible for not giving consideration to the improved performance we would secure from centralized traffic control system, even on light traffic lines. If we take into consideration the improved performance by the use of power-operated switches instead of hand throw switches, we will find the distance between sidings can be increased four to five miles, and a freight train can leave one siding and enter the next siding ten miles away with power switches in less time than the moves could be made with switches handled by trainmen with sidings spaced five miles apart. The elimination of 50 per cent of the sidings would keep the cost of centralized traffic control more in line with the cost of automatic block signals and we would still retain all advantages of operation of centralized traffic control over operation under time-table and train orders. What we are trying to impress is—we believe if you are going to install automatic block signals, do not do it until you make a study of your traffic and give centralized traffic control serious consideration."

Action Recommended

Acceptance as information.

ECONOMICS OF AUTOMATIC, AUTO-MANUAL AND
MANUAL-CONTROLLED HIGHWAY CROSSING
PROTECTION DEVICES*

Recently a number of railroads have carried out installations of modern flashing light signals with short-arm gates at street crossings. The locations and some of the details are as follows:

New York Central System

At Mishawaka, Ind., a total of 30 crossings were involved, at 20 of which the new uniform protection was provided, in lieu of various other forms previously used and 10 of which were closed. At Cleveland, Ashtabula and Conneaut, Ohio, 9 crossings were similarly equipped with new protection.

Lehigh Valley R.R.

Last year the Lehigh Valley R.R. installed A.A.R. flashing light signals with gates and sidewalk arms at eight street crossings on its two-track main line through Hazleton, Pa.

The new system is arranged for automatic operation supplemented by manual-control from two points for some of the crossings. At several locations where there are intersecting streets in close proximity to the tracks, "No Right Turn" or "No Left Turn" signs have been provided which are illuminated when the gates are lowered. Control buttons were installed at each crossing for manual emergency operation.

There are 51 through train movements daily over these crossings in addition to numerous switching and track car movements. The street traffic is heavy and averages some 5,400 vehicles and 3,400 pedestrians during a 24-hour period over each of the crossings.

Previously the crossings were protected by manually operated gates, the tender service at some of the locations being only on a part-time basis. A total daily attendance of 132 man hours was required, whereas, with the automatic operation, this has been reduced to 48 hours.

Gulf, Mobile & Ohio R.R.

New modern flashing light signals and gates have been installed at 18 crossings on the Gulf, Mobile & Ohio R.R. through Normal and Springfield, Ill. and Jackson, Tenn. in place of watchmen and manual gates. The new protection is arranged for automatic operation and selective speed controls and manual supervisory controls were provided for some of the locations.

Chicago, Milwaukee, St. Paul & Pacific R.R.

In 1949 the Chicago, Milwaukee, St. Paul & Pacific R.R. installed automatic flashing light signals with short-arm gates at two street crossings on its two-track main line in Milwaukee, Wis., replacing manually operated gates and releasing five attendants.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 12 and 505.

Economic Statement

Railroad	Location	No. of cross-ings	Total cost	Net saving	Annual return*, per cent
N. Y. C.	Mishawaka, Ind.	20	\$ 90,000†	\$10,891	12.1
	Cleveland, Ohio	6	136,000	50,224	36.9
	Ashtabula, Ohio	1	35,000	8,787	25.1
	Conneaut, Ohio	2	58,000	14,023	24.1
L. V.	Hazleton, Pa.	8	84,042	17,709	21.1
G. M. & O.	Normal, Ill.	4	40,608	15,411	37.9
	Springfield, Ill.	9	114,179	54,649	47.9
	Jackson, Tenn.	5	30,969	16,621	53.7
C. M. St. P. & P.	Milwaukee, Wis.	2	18,655	17,325	92.9

* Above the railroads' usual interest charge.

† \$90,000 railroad funds, \$65,000 public funds—Total, \$155,000.

Summary of Advantages

1. Dependable 24-hour operation.
2. Uniform and more effective type of protection.
3. Increased safety for both street traffic and train operation.
4. Reduction of operating expense.

Action Recommended

Acceptance as information.

ECONOMICS OF CAR RETARDERS AT TWO
IMPORTANT COAL TRAFFIC TERMINALS
ON THE CHESAPEAKE & OHIO RY.

The first installation of car retarders on the Chesapeake & Ohio Ry. was made at the Westbound Classification Yard, Russell, Ky., in 1929. Another installation was made at the Westbound Classification Yard, Walbridge, Ohio, in 1948. This report in a general way shows operating savings which have been effected through the period 1930 to 1948, inclusive, at Russell, Ky., and in a more detailed manner those which have been effected during the short period of time since the installation at Walbridge, Ohio.

Russell, Ky.

Russell, Ky., is the largest intermediate terminal on the Chesapeake & Ohio Ry. The Westbound Classification Yard, covered by this report, handles nothing but loaded coal cars. In 1928 a total of 558,618 cars passed through this yard; in 1948, 797,826 cars were handled.

Table I is a tabulation showing number of cars humped, cost of operation, cost per car humped, savings, etc., by years, before and after the installation of retarders. At the time of the initial installation the yard contained 21 classification tracks and the humping operations were controlled from one tower, from which the classification yard switches were operated by direct-acting EP switches, all cars being moved into the classification yard by use of car riders who returned to the hump by use of motor car on car rider return track.

The improvement consisted of revising the track layout and gradient and a complete installation of Model 28 EP car retarders controlled from three towers. In 1944 five tracks, together with additional switch machines and car retarders, were added. During 1948 a record coal loading of 34,281 cars a week occurred in May. This record was exceeded in November with a loading of 36,075 cars in one week. With this large increase in coal loading the existing facilities at Russell Terminal for handling westbound coal traffic reached the saturation point, and it was found the size of the classification yard was inadequate to take care of the business. Experience had proved that additional tracks were needed not only for handling the large volume of coal traffic but to provide sufficient additional classifications so as to minimize classification work at other terminals where further distribution of coal traffic is handled. It was, therefore, decided in order to properly take care of the present and prospective coal business at this important terminal to go ahead in 1949 with a major improvement consisting of increasing the classification yard to 52 tracks; changing the receiving yard tracks so as to permit humping two trains simultaneously over the two-track hump, together with a complete rearrangement of track layout and gradient and installation of a new car retarder plant with Model 31 EP retarders, EP direct-acting classification yard switches and power-operated skates, all controlled from four new fireproof towers; all equipped with adequate communication facilities for intercommunication between towers and yard office. The layout as now in service is shown in Fig. 1, and a photograph is shown in Fig. 2.

TABLE I
Average Cost for Handling Cars over Westbound Classification Yard at Russell, Ky.
Before and After Car Retarders Were Placed in Service
Retarders Installed in November 1929

Year	Number cars humped		Labor			Maintenance material	Total cost	Average cost per car humped	
	before	after	Switch operators	Car riders	Retarder maintenance			before	after
	retarders were installed							retarders were installed	
1928	558,618		\$ 5,869.20	\$155,510.42			\$161,379.62	\$0.2888	
1930	—	748,013	26,082.90	—	\$11,284.75	\$11,326.94	48,694.59	—	\$0.0650
1931	—	660,864	26,082.90	—	12,647.81	7,708.34	46,439.05	—	0.0702
1932	—	527,158	23,691.97	—	9,871.23	3,626.23	37,189.43	—	0.0705
1933	—	538,463	23,474.61	—	6,861.02	4,249.28	34,584.91	—	0.0642
1934	—	525,137	23,800.64	—	5,483.92	3,235.36	32,519.92	—	0.0619
1935	—	515,231	25,756.80	—	5,279.99	2,953.47	33,990.26	—	0.0659
1936	—	641,938	26,082.90	—	8,931.07	5,245.23	40,259.20	—	0.0627
1937	—	616,759	18,828.31	—	10,304.86	7,131.80	36,264.97	—	0.0587
1938	—	503,934	17,588.66	—	9,845.43	8,532.40	35,966.49	—	0.0713
1939	—	541,138	17,054.18	—	9,824.25	7,166.14	34,044.57	—	0.0629
1940	—	610,077	20,409.33	—	12,923.59	5,429.30	38,762.22	—	0.0635
1941	—	649,460	20,894.19	—	12,340.45	4,051.41	37,286.05	—	0.0574
1942	—	723,316	24,235.01	—	13,387.92	6,333.05	43,955.98	—	0.0608
1943	—	780,048	26,769.01	—	13,340.67	7,173.84	47,283.52	—	0.0606
1944	—	782,197	29,201.93	—	19,164.98	17,030.35	65,397.26	—	0.0836
1945	—	713,273	27,992.54	—	16,563.94	13,193.29	57,749.77	—	0.0809
1946	—	750,366	32,523.12	—	13,072.37	13,520.33	59,115.82	—	0.0788
1947	—	781,403	33,153.10	—	16,291.96	63,176.45	112,621.51	—	0.1441
1948	—	797,826	37,476.64	—	16,948.04	72,466.48	126,891.16	—	0.1590
Total	—	12,406,601	\$481,098.74	—	\$224,368.25	\$263,549.69	\$969,016.68	—	\$0.0781

1. Original cost of installation of retarders and modifying classification tracks for retarder operation.....	A & B	OE	Total
2. Average cost per car humped for the last 19 years.....	\$380,895	\$76,956	\$457,851
3. Average number cars humped each year for last 19 years.....	\$0.0781		
4. Average saving per car humped for last 19 years compared with 1928.....	\$652,980		
5. Average gross annual savings per year.....	\$0.2107		
6. Annual return on capital investment.....	\$110,378.75		
7. Annual return on total cost.....	28.98%		
	24.11%		

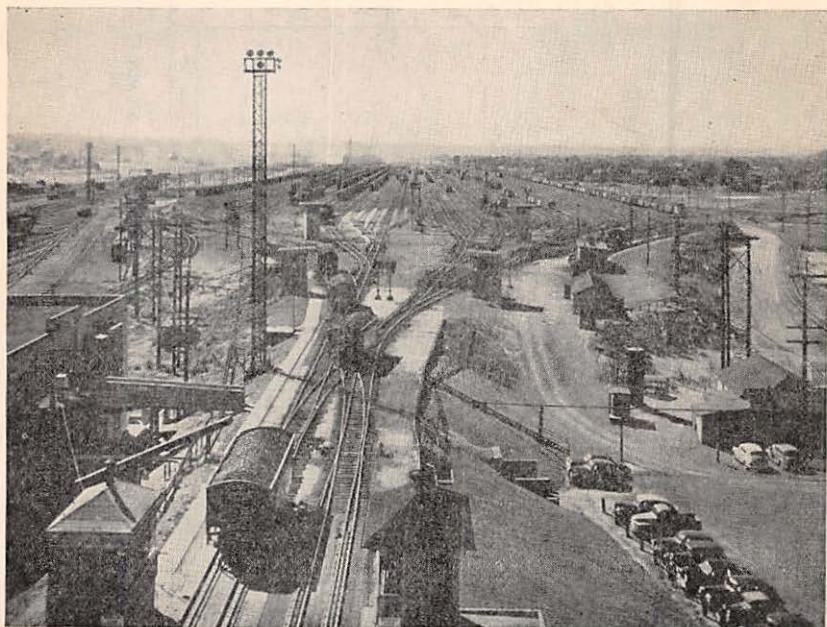


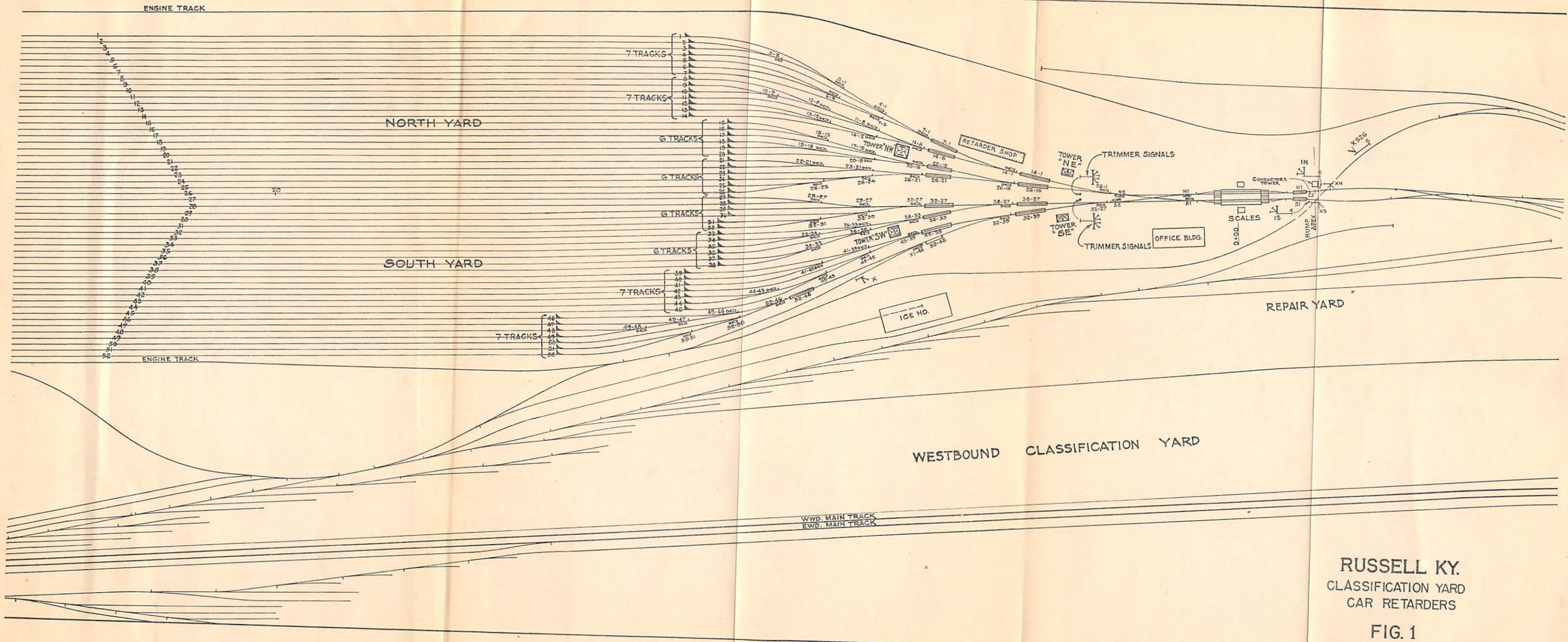
Fig. 2.
Russell, Ky.

The total cost of expanding the car retarder plant, with communication facilities, for the 52 tracks in 1949 was as follows:

A & B	OE	Total
\$460,862	\$343,796	\$804,658

It will be noted from Table I that the annual cost for maintenance materials increased an appreciable amount in 1947 and 1948. This was brought about by the inauguration of a program for replacing the worn Model 28 retarders with new Model 31 retarders which costs, subsequent to 1948, were eliminated by virtue of the major improvement made in 1949.

The savings indicated in Table I as having accrued through the period 1930 to 1948 are in comparison to actual cost of car rider operation in 1928. Actually a much greater saving has been effected because the cost of car rider operation had it been continued after 1928 would have increased materially due to rising labor costs. It is, therefore, obvious that the total savings effected since the original installation in 1929 and which will continue to be effected annually will undoubtedly result in an adequate return on the investment.



RUSSELL KY.
CLASSIFICATION YARD
CAR RETARDERS
FIG. 1

Walbridge, Ohio

By 1947, the volume of coal traffic had grown to the extent as to require immediate improvements in the Westbound Classification Yard at Walbridge, Ohio, which is the western terminal of the Hocking Division through which is handled practically all the coal for Presque Isle Dock, as well as all freight for the various connections in Toledo, Ohio. At that time, the Walbridge classification yard consisted of hand-operated classification yard switches which were handled by switch tenders, and the operation over the hump was by car riders. The first step toward increasing the capacity of this yard was to speed up operations by the use of car retarders and power-operated switches. The layout and gradient of the yard was, therefore, changed and a complete new installation of Model 31 EP car retarders with EP direct-acting switches and power-operated skate machines controlled from three new fireproof towers, equipped with adequate communication facilities, was authorized in 1947 and completed early in 1948 at a total cost of approximately \$1,900,000. The cost for the car retarder plant, including towers and all signal and communication facilities, was as follows:

A & B	OE	Total
\$821,031	\$4,000	\$825,031

Before this improvement had been completed it was found that additional classification yard tracks would be needed in handling the heavy volume of coal traffic which was constantly increasing and which was made necessary in order to provide additional classifications for economically moving loaded coal cars between this classification yard and the Presque Isle Coal Dock. Another improvement consisting of the installation of 15 additional classification tracks, with one additional tower and the required additional car retarders, switches, skates, and communication facilities was therefore installed, being placed in service in September 1948 at an additional total cost approximating \$1,300,000, of which the cost of car retarder plant and communication facilities was as follows:

A & B	OE	Total
\$227,635	\$6,500	\$234,135

The total cost of car retarder facilities for the 68-track classification yard as now in use is shown under item 1 of the economic statement, which represents the total cost for the two projects as above outlined. The layout of the tracks and car retarder facilities is shown in Fig. 3 and a photograph is shown in Fig. 4.

Subsequent to the initial installation in 1948, but before the 15 additional tracks were added to the classification yard, an economic study was made, selecting the period March 1 to September 15, 1947 for obtaining cost of operation prior to the installation and the period March 1 to September 15, 1948 for determining the cost of operation after installation. The number of cars humped for these periods amounted to 231,831 and 257,073, respectively, or an increase for the period after installation of 25,242.

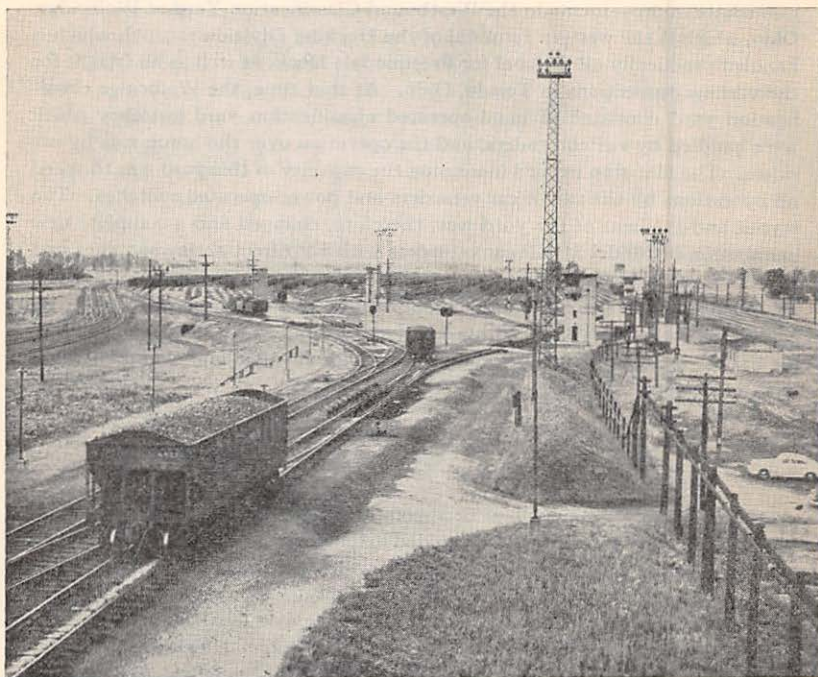


Fig. 4.
Walbridge, Ohio.

Taking into consideration only the items of operation directly effected by the installation of car retarders: namely, elimination of car riders and switch tenders, as well as a small reduction in the amount of damage to cars, a gross annual saving of \$270,352 is being effected. Allowing for an increase in annual operating expenses amounting to \$25,232, covering cost of labor and material for maintenance of the car retarder plant and communication facilities, together with a deduction for interest charges of 4 per cent, leaves a net annual saving of \$203,173, equivalent to an annual return on capital investment of 19.4 per cent, as shown in the economic statement which follows. Other savings indirectly attributable to the improved method of operation, including a reduction in yard crew expense actually amounting to 395 yard crew days during 6½ month period, March 1 to September 15, 1948, but which may have been largely due to speeding up of humping operations with the car retarder plant, are not included in this report.

Economic Statement (Walbridge, Ohio)

1. Cost of Installation:	
(a) Capital Investment.....	\$1,048,666
(b) Operating Expenses.....	10,500
(c) Total.....	<u>\$1,059,166</u>
2. Gross Saving per Annum.....	\$ 270,352
3. Increased Annual Operating Expenses.....	25,232
4. Net Reduction in Annual Operating Expenses.....	<u>\$ 245,120</u>
5. Deduction for Interest Charges @ 4% (of 1-a).....	41,947
6. Net Saving per Annum.....	<u>\$ 203,173</u>
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	19.4%
(b) On Total Cost ($6 \div 1-c$).....	19.2%

Summary of Advantages of Car Retarders

1. Classification yard capacity has been increased.
2. Humping operations have been expedited.
3. Operating expenses have been reduced by eliminating car riders and switch tenders.
4. Damage to equipment and lading has been decreased.

Action Recommended

Acceptance as information.

ECONOMICS OF RETIREMENT OF SECOND TRACK AND SIDING AND CONVERTING SECOND TRACK TO SIDING IN
CENTRALIZED TRAFFIC CONTROL TERRITORY ON
THE ST. LOUIS-SAN FRANCISCO RY. BETWEEN
NEWBURG AND LEBANON, MO.

History.

In 1943, the St. Louis-San Francisco Ry. installed 46.5 miles of centralized traffic control* between Dillon and Swedeborg, Mo. In 1944, a 22-mile section west from Swedeborg to Sleeper was added to the first installation. In 1946, centralized traffic control was installed from Sleeper to Springfield, 65 miles, making a total of 133.5 miles of road on the 239.1 miles of road between St. Louis and Springfield, Mo. (See Fig. 1.)

Of the 76.2 road miles between Dillon and Lebanon, 13.9 miles were equipped with two tracks, most of which was on a separate right-of-way, as shown in Figs. 2, 3 and 5.

On account of the severe grades, maximum 2.54 per cent, and numerous 3, 5, 6 and 10-degree curves in this territory, helper service was in operation in 1943 between Newburg and Dillon, 13.5 miles, on eastward trains and between Newburg and Dixon Wye, 14.4 miles on westward trains.

Since the war-time peak traffic in 1943, the Frisco adopted Diesel operation with longer and fewer trains so that in 1948 the average daily traffic compared with the 1943 traffic was as follows:

Type train	1943	1948
Passenger.....	16	8
Freight.....	32	12
Helpers.....	20	—
Total.....	68	20

The 1948 traffic of 20 trains daily did not warrant the continued operation of the 13.9 miles of second track and studies showed that 11 miles of second track could be retired, 2.9 miles of second track converted to sidings, and one siding 1.2 miles in length could be removed with delays to train operation averaging less than 2 minutes per train per day. The second track retired was part of the original railway line on a separate right-of-way with heavier grades and curves than the main track retained.

* *Railway Signaling*, March 1944, pp. 144-151.

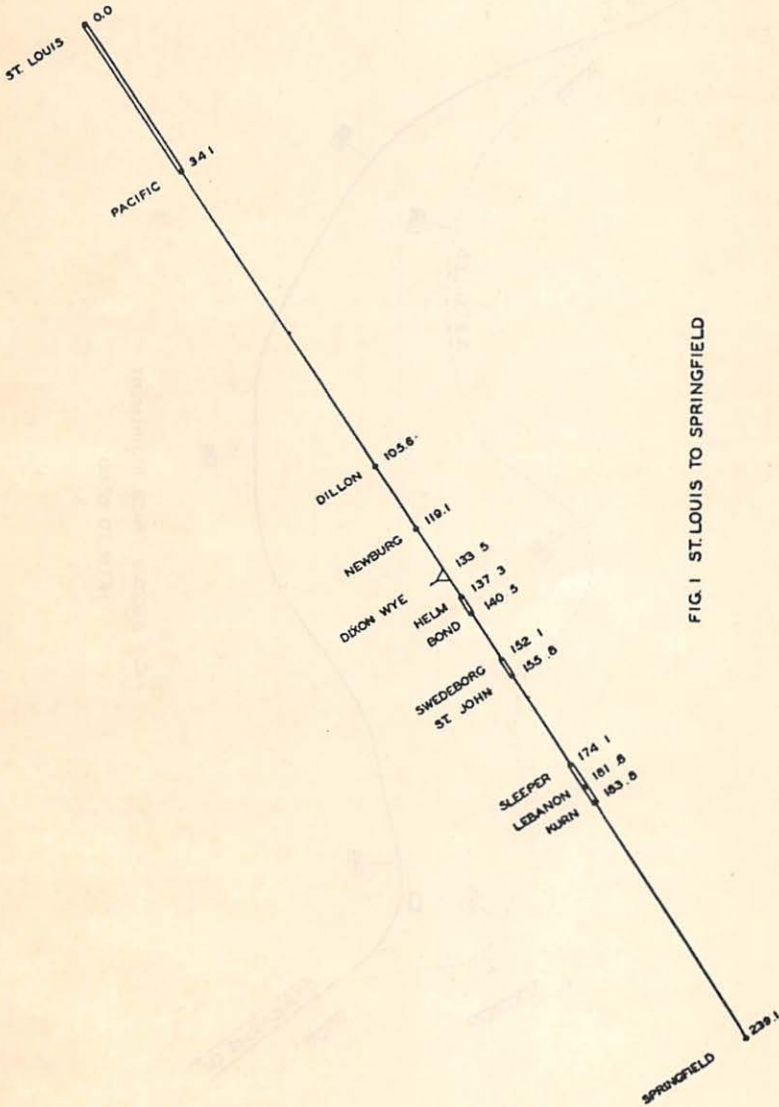


FIG. 1 ST. LOUIS TO SPRINGFIELD

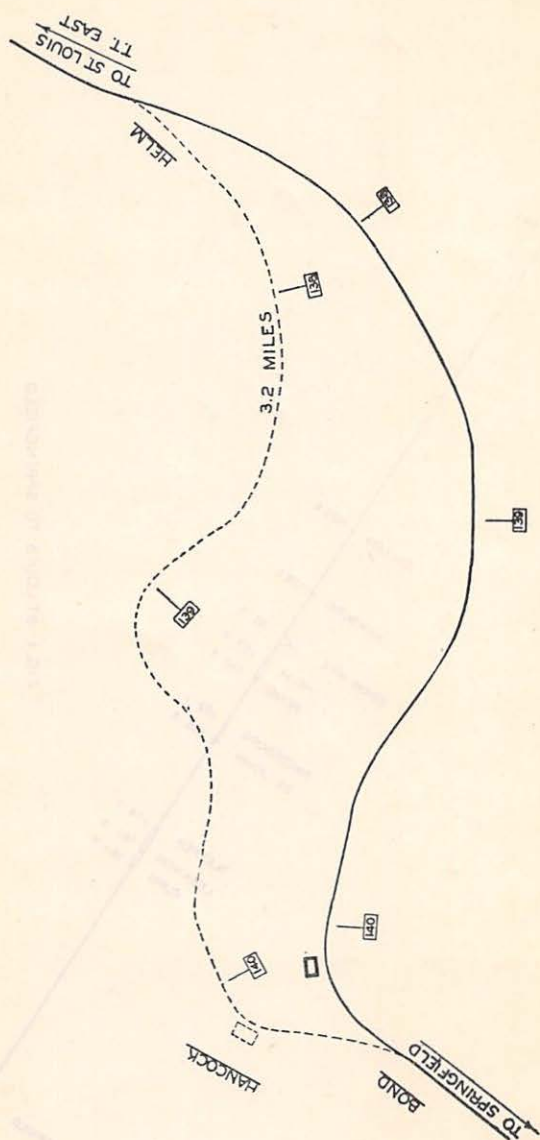


FIG. 2 SECOND TRACK RETIREMENT
HELM TO BOND

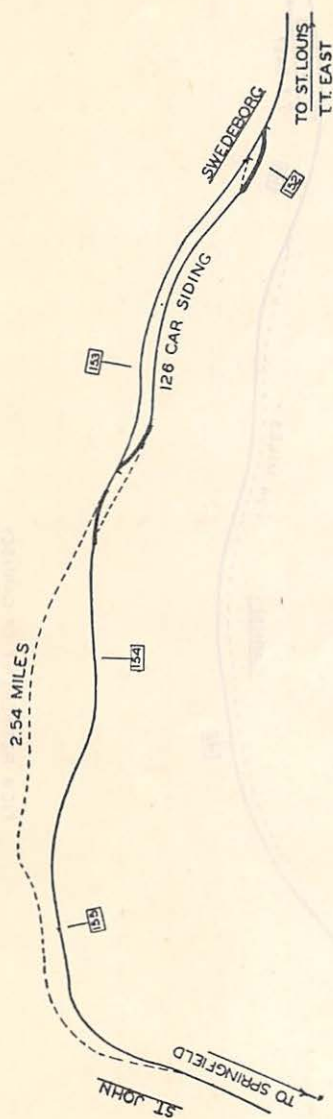
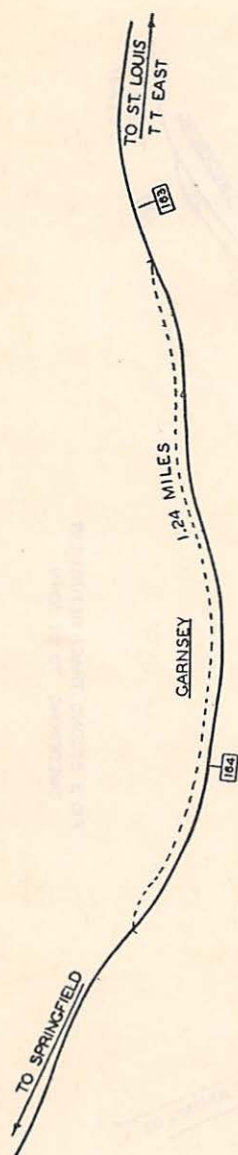


FIG. 3 SECOND TRACK RETIREMENT
SWEDEBORG TO ST. JOHN

FIG 4 RETIREMENT OF GARNSEY
PASSING TRACK

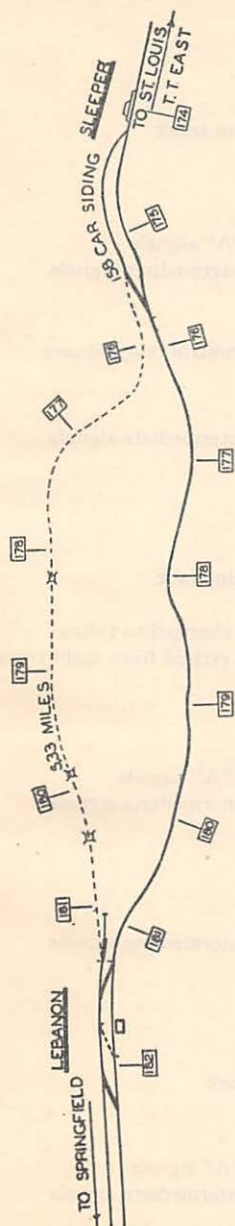


FIG. 5 SECOND TRACK RETIREMENT
SLEEPER TO LEBANON, MO.

Track and signal changes.

The changes involved four projects, the major changes and additions being as follows:

1. Helm to Bond, Fig. 2.

Track facilities retired:

- 3.2—miles of second main track
- 2—No. 20 turnouts
- 1—station depot

Signaling retired:

- 2—two-arm SL high "A" signals
- 3—one-arm SL high intermediate signals
- 2—power switches
- 9—track circuits
- 2—centralized traffic control relay houses
- 3.26—miles of pole line

Signaling added:

- 2—one-arm SL high intermediate signals
- 3.26—miles of pole line

2. Swedeborg to St. John, Fig. 3.

Track facilities retired:

- 2.54—miles of second main track
- 2—No. 20 turnouts
- 1.3—miles second track changed to siding
- 1—house track switch retired from main track

Track facilities added:

- 2—No. 15 turnouts

Signaling retired:

- 2—one-arm SL dwarf "A" signals
- 5—one-arm SL high intermediate signals
- 10—track circuits
- 2—electric locks
- 2.54—miles of pole line

Signaling added:

- 2—one-arm SL high intermediate signals
- 2.54—miles of pole line

3. Garnsey passing track, Fig. 4.

Track facilities retired:

- 1.24—miles of passing track
- 2—No. 15 turnouts

Signaling retired:

- 2—two-arm SL high "A" signals
- 4—one-arm SL high intermediate signals
- 2—power switches
- 2—track circuits
- 2—centralized traffic control relay houses

4. Sleeper to Lebanon, Fig. 5.

Track facilities retired:

5.33—miles of second track

1—No. 20 crossover

1.57—miles of second track changed to siding

1—house track switch retired from main track

Track facilities added:

1—No. 10 crossover

2—No. 20 turnouts

Signaling retired:

2—two-arm SL high "A" signals

2—one-arm SL high "A" signals

3—one-arm SL dwarf "A" signals

5—one-arm SL high intermediate signals

2—power switches

9—track circuits

1—electric lock

5.33—miles of pole line

Signaling added:

2—two-arm SL high "A" signals

2—one-arm SL high "A" signals

2—one-arm SL dwarf "A" signals

1—one-arm SL high intermediate signal

2—power switches

2—track circuits

2—electric locks

4.88—miles of pole line

Track and signal estimates for retirements and changes.

The approximate cost of the retirements and changes on the four projects was as follows:

	Helm- Bond	Swedeberg- St. John	Garnsey	Sleeper- Lebanon	Total
1. Investment credit for property retired.....	\$168,345	\$128,000	\$30,000	\$288,000	\$614,345
2. Charge to Dep. Res. for depreciable property retired.....	36,530	22,200	13,500	53,500	125,730
3. Gross operating expense for property retired.....	131,815	105,800	16,500	234,500	488,615
4. Operating expense cost to demolish and rearrange facilities.....	16,731	18,623	4,425	37,902	77,681
5. Value of salvage recovered.....	50,060	32,910	23,058	68,917	174,945
6. Net cost to operating expense (3 plus 4 minus 5).....	98,486	91,513	none	203,485	393,484
7. Investment charge for property added.....	13,642	36,395	1,244	15,159	66,440

The construction work on the four projects was started in June 1949 and completed in December 1949. The track and signal material reclaimed from these projects is being used on other centralized traffic control installations on the Frisco lines.

Reduction in annual operating expenses.

The major items involved in reduced annual operating expenses are the saving due to maintenance of the track and signal facilities retired, the depreciation on the signaling and other depreciable property retired, local taxes, and the State and Federal income tax saving. The estimated saving for each of the projects is as follows:

Helm to Bond

Reduced annual operating expenses:

Maintenance on 3.2 miles of second track.....	\$ 7,680
2 turnouts.....	200
station depot.....	200
signal facilities.....	1,350
Taxes on facilities retired.....	520
Depreciation on facilities retired.....	850
Total.....	<u>\$10,800</u>

Income tax saving:

Total operating expense for project.....	\$98,486
Less	
Adjustment for loss in value sustained prior to	
March 1, 1913.....	\$19,800
First year saving in operating expenses.....	10,800 30,600
Gross additional income tax deduction.....	\$67,886
Income tax saving 42% of \$67,886.....	\$28,512

Note.—Income tax saving is based on 38% Federal, 2% State and 2% penalty tax account making consolidated tax return for entire system and is non-recurring.

Swedeborg to St. John

Reduced annual operating expenses:

Maintenance on 2.54 miles of second track.....	\$ 6,096
1.3 miles of siding.....	83
1 main line switch.....	100
signal facilities.....	1,350
Taxes on facilities retired.....	300
Depreciation on facilities retired.....	955
Total.....	<u>\$ 8,884</u>

Sept. 1950]

Com. I—Economics of Ry. Signaling

Income tax saving:

Total operating expense for project.....	\$91,513	
Less		
Adjustment for loss in value sustained prior to		
March 1, 1913.....	\$15,870	
First year saving in operating expenses.....	8,884	24,754
Gross additional income tax deduction.....	\$66,759	
Income tax saving 42% of \$66,759.....		\$28,039

Garnsey Siding

Reduced annual operating expenses:

Maintenance on 1.24 miles of passing track.....	\$ 1,706
2 No. 15 switches.....	200
signal facilities.....	1,600
Taxes on facilities retired.....	100
Depreciation on facilities retired.....	600
Total.....	\$ 4,206

Sleeper to Lebanon

Reduced annual operating expenses:

Maintenance on 5.33 miles of second track.....	\$12,792
1.57 miles of siding.....	100
signal facilities.....	1,100
Taxes on facilities retired.....	880
Depreciation on facilities retired.....	467
Total.....	\$15,339

Income tax saving:

Total operating expense for project.....	\$203,485	
Less		
Adjustment for loss in value sustained prior to		
March 1, 1913.....	\$35,175	
First year saving in operating expenses.....	15,339	50,514
Gross additional income tax deduction.....	\$152,971	
Income tax saving 42% of \$152,971.....		\$64,248

Summary of Reduced Operating Expenses

Project	Annual maintenance saving	Income tax saving	Total saving
Helm—Bond.....	\$10,800	\$ 28,512	\$ 39,312
Swedeborg—St. John.....	8,884	28,039	36,923
Garnsey.....	4,206	none	4,206
Sleeper—Lebanon.....	15,339	64,248	79,587
Total.....	\$39,229	\$120,799	\$160,028

Summary of Advantages of Four Projects

1. Provided a more economical track and signal layout for existing traffic conditions.
2. Reduced annual operating expenses \$39,229 per year.
3. Provided an income tax saving of \$120,799.
4. Provided an estimated salvage of \$174,945.
5. Removed two switches from main track.
6. Released track and signal material for use at other points.
7. Reduced the trackage required for meets and passes.
8. Saved the necessity at some future time of making rail renewal on the track abandoned.

Action Recommended

Acceptance as information.

**FORMULA FOR ESTIMATING TRAIN MILES SAVED
DUE TO INCREASED TONNAGE WITH
CENTRALIZED TRAFFIC CONTROL**

At the 1949 Annual Meeting* the Committee presented a report on this subject which included a table showing road freight train crew's wages and specified elements of freight service cost per ordinary train mile for the calendar year 1947.

The same data for the calendar year 1948 is shown in following Table I:

TABLE I

**Road Freight Train Crew's Wages and Specified Elements of Freight Service
Cost per Ordinary Train Mile—Calendar Year 1948**

Railroad	Road freight train crews wages a	Fuel, supplies, enginehouse expense and locomotive repairs b	Payroll taxes on crew wages and labor applicable to locomotive repairs and shop and enginehouse expense c	Total
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	103.04¢	221.51¢	9.61¢	334.16¢
2 Boston & Maine.....	101.95	165.78	9.49	277.22
3 Central Vermont.....	91.96	199.24	8.87	300.07
4 Maine Central.....	94.14	196.12	9.27	299.53
5 New York, New Haven & Hartford.....	105.04	208.71	10.32	324.07
6 Rutland.....	86.55	213.46	9.18	309.19
GREAT LAKES REGION:				
7 Grand Trunk Western.....	76.10	161.45	6.91	244.46
8 Erie (Incl. Chgo. & Erie).....	107.97	215.48	10.84	334.29
9 New York, Chicago & St. Louis.....	81.31	185.70	8.20	275.21
10 Delaware & Hudson.....	102.63	324.80	13.42	440.85
11 Delaware, Lackawanna & Western.....	113.22	200.49	9.91	323.62
12 Lehigh & New England.....	141.52	205.75	10.98	358.25
13 Lehigh Valley.....	122.02	238.62	11.17	371.81
14 Monongahela.....	154.64	181.53	12.66	348.83
15 New York, Ontario & Western.....	108.93	138.18	9.58	256.69
16 New York Central (Incl. B. & A.).....	103.38	204.98	10.22	318.58
17 Pittsburgh & Lake Erie.....	114.88	301.85	11.83	428.56
18 Ann Arbor.....	72.78	143.25	6.98	223.01
19 Wabash.....	75.78	154.67	7.24	237.69
CENTRAL EASTERN REGION:				
20 Baltimore & Ohio.....	117.58	249.29	12.43	379.30
21 Bessemer & Lake Erie.....	131.11	683.66	26.45	841.22
22 Chicago & Eastern Illinois.....	77.74	161.38	7.88	247.00
23 Chicago, Indianapolis & Louisville.....	76.52	143.06	7.26	226.84
24 Detroit, Toledo & Ironton.....	82.11	170.90	7.22	260.23
25 Elgin, Joliet & Eastern.....	198.64	210.02	15.90	424.56
26 Illinois Terminal.....	80.58	96.31	6.54	183.43
27 Long Island.....	321.79	406.18	26.07	754.04
28 Pennsylvania.....	140.34	246.76	13.05	400.15
29 Cent. R.R. of New Jersey (Incl. C.R.R. of Pa.).....	155.70	286.99	14.39	457.08
30 Reading.....	120.99	249.62	12.33	382.94
31 Western Maryland.....	115.22	208.00	14.35	337.57
32 Wheeling & Lake Erie.....	102.06	158.05	8.95	269.06

a Includes freight proportion of charges to operating expense Accounts 392, 393 and 401.

b Includes freight proportion of charges to operating expense Accounts 308, 311, 394 to 400, inclusive, and 402.

c Payroll taxes calculated at rate of 6 per cent. Reduction from actual rate of 6.25 per cent account compensation in excess of \$300 per month.

Note.—The figures in this table are dollars and cents, i.e., 103.04¢ equals \$1.0304; 91.96¢ equals \$0.9196; 9.61¢ equals \$0.0961, etc.

* A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 28 and 507.

TABLE I—Continued

Railroad	Road freight train crews wages ^a	Fuel, supplies, enginehouse expense and locomotive repairs ^b	Payroll taxes on crew wages and labor applicable to locomotive repairs and shop and enginehouse expense ^c	Total
POCAHONTAS REGION:				
33 Chesapeake & Ohio (Incl. Pere M.).....	95.54¢	223.92¢	9.94¢	329.40¢
34 Norfolk & Western.....	92.34	279.68	10.96	382.98
35 Richmond, Fred'burg & Potomac.....	75.21	218.98	8.70	302.89
36 Virginian.....	108.81	290.16	12.88	411.85
SOUTHERN REGION:				
37 Atlantic Coast Line.....	80.64	150.10	7.17	237.91
38 Clinchfield.....	121.89	284.76	12.81	419.46
39 Louisville & Nashville.....	86.14	104.07	8.53	258.74
40 Nashville, Chattanooga & St. Louis.....	83.78	142.16	8.08	234.02
41 Florida East Coast.....	77.86	205.04	7.62	290.52
42 Gulf, Mobile & Ohio (Incl. Alton).....	78.77	151.59	7.77	238.13
43 Central of Georgia.....	69.67	148.15	6.72	224.54
44 Illinois Central (Incl. Y. & M. V.).....	79.37	154.06	7.56	240.99
45 Norfolk Southern.....	91.21	126.47	7.88	225.56
46 Seaboard Air Line.....	89.48	173.42	8.55	271.45
47 Alabama Great Southern.....	69.44	173.63	7.86	250.93
48 Cincinnati, New Orleans & Tex. Pac.....	69.23	160.63	7.68	237.54
49 Southern.....	77.08	161.66	8.16	246.90
NORTHWESTERN REGION:				
50 Minneapolis, St. Paul & S. Ste. Marie.....	94.17	151.54	8.22	253.93
51 Chicago & North Western.....	94.09	183.24	9.02	286.35
52 Chicago, St. Paul, Mpls. & Omaha.....	91.51	176.66	8.22	276.39
53 Chicago Great Western.....	82.54	125.43	6.42	214.39
54 Chicago, Milwaukee, St. Paul & Pac.....	94.62	166.61	8.39	269.62
55 Duluth, Missabe & Iron Range.....	128.74	322.63	13.41	464.78
56 Great Northern.....	97.68	218.51	9.65	325.84
57 Minneapolis & St. Louis.....	87.08	119.62	7.59	214.29
58 Northern Pacific.....	105.12	175.46	9.77	290.35
59 Spokane, Portland & Seattle.....	123.57	188.30	9.95	321.82
CENTRAL WESTERN REGION:				
60 Atchison, Topeka & Santa Fe.....	82.87	178.50	7.96	269.33
61 Chicago, Burlington & Quincy.....	82.52	124.33	6.67	213.52
62 Colorado & Southern.....	81.74	164.92	7.42	254.08
63 Fort Worth & Denver City.....	76.72	158.72	6.85	242.29
64 Denver & Rio Grande W. (Incl. D. & S. L.).....	108.12	240.46	11.40	359.98
65 Rock Island System.....	81.50	146.38	7.04	234.92
66 Northwestern Pacific.....	148.46	164.44	11.60	324.50
67 Southern Pacific.....	134.60	285.16	13.74	433.50
68 Union Pacific.....	99.22	204.02	8.98	312.22
69 Western Pacific.....	102.83	199.11	10.32	312.26
SOUTHWESTERN REGION:				
70 Frisco Lines.....	76.33	151.52	6.84	234.69
71 Kansas City Southern.....	79.57	173.18	7.54	260.29
72 Louisiana & Arkansas.....	81.82	186.56	7.64	276.02
73 Missouri-Kansas-Texas.....	74.68	155.24	6.82	236.74
74 Gulf Coast Lines.....	86.41	152.57	7.82	246.80
75 International-Great Northern.....	79.60	169.30	7.43	256.33
76 Missouri Pacific.....	86.35	136.60	7.53	230.48
77 Texas & Pacific.....	80.97	210.71	8.17	299.85
78 St. Louis Southwestern.....	88.78	158.96	7.53	255.27
79 Texas & New Orleans.....	76.51	168.92	7.36	252.79
Composite Average.....	97.94	195.13	9.45	302.52

^a Includes freight proportion of charges to operating expense Accounts 392, 393 and 401.^b Includes freight proportion of charges to operating expense Accounts 308, 311, 394 to 400, inclusive, and 402.^c Payroll taxes calculated at rate of 6 per cent. Reduction from actual rate of 6.25 per cent account compensation in excess of \$300 per month.

Note.—The figures in this table are dollars and cents, i.e., 103.04¢ equals \$1.0304; 91.96¢ equals \$0.9196; 9.61¢ equals \$0.0961, etc.

TABLE 1—Continued

Railroad	Road freight train crews wages a	Fuel supplies, enginehouse expense and locomotive repairs b	Payroll taxes on crew wages and labor applicable to locomotive repairs and shop and enginehouse expense c	Total
AVERAGES BY REGIONS:				
New England.....	100.75¢	193.35¢	9.71¢	303.81¢
Great Lakes.....	99.62	204.06	9.84	313.52
Central Eastern.....	129.63	243.45	12.69	385.77
Pocahontas.....	94.68	244.73	10.38	349.79
Southern.....	81.27	160.89	8.00	250.16
Northwestern.....	97.31	180.85	8.98	287.14
Central Western.....	98.03	197.03	9.24	304.30
Southwestern.....	80.94	159.08	7.38	247.40

a Includes freight proportion of charges to operating expense Accounts 392, 393 and 401.**b** Includes freight proportion of charges to operating expense Accounts 308, 311, 394 to 400, inclusive, and 402.**c** Payroll taxes calculated at rate of 6 per cent. Reduction from actual rate of 6.25 per cent account compensation in excess of \$300 per month.**Note.**—The figures in this table are dollars and cents, i.e., 103.04¢ equals \$1.0304; 91.96¢ equals \$0.9196; 9.61¢ equals \$0.0961, etc.

Action Recommended

Acceptance as information.

EFFECT OF VARIOUS CLASSES OF TRACK ON TAXATION†

The State and Local taxes per mile of track operated in 1948 vary from a minimum of \$198 to a maximum of \$4,140, with a composite average for 79 railroads, of \$814. This information has been developed through cooperation with the Bureau of Railway Economics, A.A.R. and is shown in following Table I:

TABLE I
State and Local Taxes per Mile of Track Operated
Calendar Year 1948

Railroad	Total miles of all track operated at close of year	State and local taxes*	
		Total	Per mile of track operated
NEW ENGLAND REGION:			
1 Bangor & Aroostook.....	872.05	\$584,768	\$671
2 Boston & Maine.....	3,357.25	2,943,424	877
3 Central Vermont.....	614.88	133,615	217
4 Maine Central.....	1,330.48	951,476	715
5 New York, New Haven & Hartford.....	4,391.03	5,015,967	1,142
6 Rutland.....	524.00	140,728	269
GREAT LAKES REGION:			
7 Grand Trunk Western.....	2,152.91	1,049,579	488
8 Erie (Incl. Chgo. & Erie).....	5,680.10	5,635,782	992
9 New York, Chicago & St. Louis.....	2,944.97	2,158,772	733
10 Delaware & Hudson.....	1,740.82	1,492,272	857
11 Delaware, Lackawanna & Western.....	2,429.02	4,202,125	1,730
12 Lehigh & New England.....	325.89	208,674	640
13 Lehigh Valley.....	3,008.37	2,733,540	909
14 Monongahela.....	276.16	263,116	953
15 New York, Ontario & Western.....	853.19	169,050	198
16 New York Central (Incl. B. & A.).....	24,218.11	26,677,861	1,102
17 Pittsburgh & Lake Erie.....	1,065.08	1,078,819	1,013
18 Ann Arbor.....	419.31	186,276	444
19 Wabash.....	4,311.46	2,127,367	493
CENTRAL EASTERN REGION:			
20 Baltimore & Ohio.....	12,072.48	8,218,006	681
21 Bessemer & Lake Erie.....	576.22	545,795	947
22 Chicago & Eastern Illinois.....	1,616.14	703,834	436
23 Chicago, Indpls. & Louisville.....	819.57	400,232	488
24 Detroit, Toledo & Ironton.....	679.64	483,790	712
25 Elgin, Joliet & Eastern.....	1,087.69	948,899	872
26 Illinois Terminal.....	662.39	432,651	653
27 Long Island.....	923.36	3,822,565	4,140
28 Pennsylvania.....	25,122.08	28,425,950	1,132
29 Cent.R.R. of New Jersey (Incl. C.R.R. of Pa.).....	1,763.13	3,556,993	2,017
30 Reading.....	3,354.75	2,922,276	871
31 Western Maryland.....	1,401.80	1,300,904	928
32 Wheeling & Lake Erie.....	1,015.24	1,090,519	1,074
POCAHONTAS REGION:			
33 Chesapeake & Ohio (Incl. Pere M.).....	9,715.40	9,973,084	1,027
34 Norfolk & Western.....	4,726.28	6,260,355	1,326
35 Richmond, Fred'burg & Potomac.....	482.26	663,604	1,376
36 Virginian.....	1,113.81	1,815,209	1,630

* Represents total tax accruals other than United States Government taxes.

† A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 32 and 507.

Sept. 1950]

Com. I—Economics of Ry. Signaling

TABLE I—Continued

Railroad	Total miles of all track operated at close of year	State and local taxes*	
		Total	Per mile of track operated
SOUTHERN REGION:			
37 Atlantic Coast Line.....	7,952.37	\$4,039,226	\$508
38 Clinchfield.....	478.15	901,512	1,885
39 Louisville & Nashville.....	7,919.78	7,539,450	952
40 Nashville, Chattanooga & St. Louis.....	1,715.26	1,214,998	708
41 Florida East Coast.....	1,225.27	909,860	743
42 Gulf, Mobile & Ohio (Incl. Alton).....	4,311.42	2,348,166	545
43 Central of Georgia.....	2,695.25	1,312,116	487
44 Illinois Central (Incl. Y. & M. V.).....	11,189.94	11,381,215	1,017
45 Norfolk Southern.....	869.31	306,379	352
46 Seaboard Air Line.....	5,829.46	3,458,767	593
47 Alabama Great Southern.....	682.78	734,272	1,075
48 Cincinnati, New Orleans & Tex. Pac.....	880.45	1,524,184	1,731
49 Southern.....	10,507.41	8,438,884	803
NORTHWESTERN REGION:			
50 Minneapolis, St. Paul & S. Ste. Marie.....	1,761.40	2,358,834	1,339
51 Chicago & North Western.....	12,302.51	5,805,995	472
52 Chicago, St. Paul, Mpls. & Omaha.....	2,418.66	1,190,635	492
53 Chicago Great Western.....	2,717.01	986,885	363
54 Chicago, Milwaukee, St. Paul & Pac.....	15,975.44	9,015,493	564
55 Duluth, Missabe & Iron Range.....	1,221.77	2,343,272	1,918
56 Great Northern.....	12,180.62	11,820,146	970
57 Minneapolis & St. Louis.....	1,761.40	586,490	333
58 Northern Pacific.....	10,622.83	8,228,646	775
59 Spokane, Portland & Seattle.....	1,273.15	1,278,231	1,004
CENTRAL WESTERN REGION:			
60 Atchison, Topeka & Santa Fe.....	21,226.67	15,425,733	727
61 Chicago, Burlington & Quincy.....	13,489.69	8,493,007	630
62 Colorado & Southern.....	1,197.66	584,233	488
63 Fort Worth & Denver City.....	1,172.24	313,521	267
64 Denver & Rio Grande W. (Incl. D. & S. L.).....	3,878.04	2,879,025	742
65 Rock Island System.....	11,223.65	5,776,996	515
66 Northwestern Pacific.....	464.66	176,242	379
67 Southern Pacific.....	13,349.13	14,956,981	1,120
68 Union Pacific.....	15,841.53	14,977,777	945
69 Western Pacific.....	1,920.98	1,158,904	603
SOUTHWESTERN REGION:			
70 Frisco Lines.....	6,785.45	3,641,260	537
71 Kansas City Southern.....	1,428.91	1,234,797	864
72 Louisiana & Arkansas.....	998.35	557,943	559
73 Missouri-Kansas-Texas.....	4,679.03	2,035,123	435
74 Gulf Coast Lines.....	1,657.04	486,018	293
75 International-Great Northern.....	1,531.11	405,258	265
76 Missouri Pacific.....	10,540.01	4,918,830	467
77 Texas & Pacific.....	2,729.00	1,203,616	441
78 St. Louis Southwestern.....	2,388.99	1,126,105	471
79 Texas & New Orleans.....	6,112.27	2,676,148	438
Composite Average.....	368,753.37	300,078,050	814
AVERAGES BY REGIONS:			
New England.....	11,089.69	9,769,978	881
Great Lakes.....	49,425.39	47,983,233	971
Central Eastern.....	51,094.49	52,852,414	1,034
Poahontas.....	16,037.75	18,721,252	1,167
Southern.....	56,256.85	44,109,029	784
Northwestern.....	62,234.79	43,614,627	701
Central Western.....	83,764.25	64,742,419	773
Southwestern.....	38,850.16	18,285,098	471

* Represents total tax accruals other than United States Government taxes.

Action Recommended

Acceptance as information.

TRAIN HOUR VALUE*

This revised report outlines a recommended method for determining the value of a train hour using as the basis the average cost items included in Annual Report Form A submitted by Class I railroads to the I.C.C.

The average costs so developed may be adjusted to fit local conditions on any railroad or subdivision under study, giving consideration to the factors which make up the cost of the train hour, taking credit for such of those factors shown in Table I as will be saved in evaluating the saved train hour. To such costs must be added the estimated value of intangibles, some of which are mentioned in this report, in order to obtain total Train Hour Value. Thus, Train Hour Value is comprised of "out-of-pocket" train hour costs, plus the value placed upon intangibles.

When knowing the Train Hour Value (THV) and the train hours saved, the total saving to be effected is the product of the two.

Table I shows account numbers according to I.C.C. classification, page references to locate the items of cost in Annual Report Form A and formula for the final calculation.

TABLE I

Items	I.C.C. Account Classification	Form A Report Reference (1948)
1. Overtime wages.....		Page 524
Wages, train and enginemen.....	392-393 & 401	Schedule 561-B
2. Train fuel.....	394	
3. Water for train locomotives.....	397	
4. Lubricants for train locomotives.....	398	Page 309
5. Other supplies for train locomotives.....	399	Schedule 320
6. Enginehouse expenses—train.....	400	
7. Train supplies and expenses.....	402	
8. Locomotive repairs.....	308 & 311	Page 307
9. Locomotive depreciation.....	331	Schedule 320
(Sub-accounts 51 & 52)		Page 313-B
10. Interest on locomotive investment.....		Schedule 320-F
11. Payroll taxes.....		

In addition, the following information must be obtained:

A. Road freight train hours.....	Item 64 Col. B	Page 508
		Schedule 531

Formula

$$\text{B. Train Hour Cost} = \frac{\text{Sum of Items 1 to 11}}{\text{Item A}}$$

* A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 34 and 508.

The following explanations refer to the items enumerated in Table I:

ITEM 1—WAGES

Wages are only to be considered when on overtime basis. Generally, records are available on each railroad of actual overtime costs and when available should be used for this item. The following explanations will be useful in cases where it will be necessary to calculate the amount of overtime.

Road freight overtime.

Road employees are paid on the basis of the miles of the train run. If it takes longer than a certain time to run the miles paid for, then overtime is paid in addition to payment for the mileage made.

For all employees in road freight service, "eight hours or less—100 miles or less" constitute a day's work for pay purposes.

In all cases, a basic day's pay is guaranteed, no matter how few miles or hours an employee works. On the other hand, where an employee runs more than his "basic day's mileage" he is paid proportionately for each excess mile run.

Thus, all road freight employees receive a basic day's pay for runs up to 100 miles and are paid for each additional mile run at a rate which is 1/100 of the basic daily rate.

Road overtime starts on all freight runs where the time on duty exceeds the time obtained by dividing the mileage made by $12\frac{1}{2}$ miles per hour, with a minimum of eight hours, as shown by the following examples:

Miles	Overtime starts after
90	8 hours
100	8 hours
125	10 hours
135	10 hours 48 minutes
150	12 hours
175	14 hours
180	14 hours 24 minutes

Improved methods of train operation reduce the time of trains on the road and frequently eliminate or reduce overtime wages paid train and engine crews.

The reduction in overtime hours may be forecast by the process of plotting and redispaching train movements.

The reduced number of overtime hours, having been determined for a representative test period, are then projected to an annual basis.

The final step consists of multiplying the overtime hours saved by the overtime rate which determines the annual saving. Where two classes of service are involved (through freight and local freight), the rate applicable to each should be determined and used.

The hourly overtime rate is obtained by dividing the basic daily rate by 8 (hours per day) and multiplying by 1.5.

To the amount thus obtained should be added payroll taxes, railroad retirement and unemployment insurance and, in addition, State taxes in some instances.

Examples of Determining Overtime Rates

Through Freights

Class of employee	No. of employees	Basic daily rate (8 hours)	Total
Engineman	1	\$13.87	\$13.87
Fireman	1	12.03	12.03
Conductor	1	12.06	12.06
Brakemen	2	10.64	21.28
Total basic day train rate.....			\$59.24
Train hour rate.....			\$ 7.40
Overtime hourly rate.....			\$11.10
Add 6 per cent for payroll taxes.....			0.67
Total overtime hourly rate.....			\$11.77

Local Freights

Engineman	1	\$14.39	\$14.39
Fireman	1	12.43	12.43
Conductor	1	12.62	12.62
Brakemen	3	11.07	33.21
Total basic day train rate.....			\$72.65
Train hour rate.....			\$ 9.08
Overtime hourly rate.....			\$13.62
Add 6 per cent for payroll taxes.....			0.82
Total overtime hourly rate.....			\$14.44

The foregoing figures are typical for an average locomotive and at rates effective October 1, 1948. Each railroad should use rates applicable on the territory involved.

Initial and Final Terminal Delay, Road Freights

Terminal delay on road freight trains may result in arbitrary additional payments for time at the initial and final terminals, depending upon the wage agreements in effect.

If the improved facilities expedite the terminal operations, a check of the initial and final terminal payments should be made to determine the difference in crew wages.

When road overtime accrues during any trip or tour of duty, in no cases will payment for both initial terminal delay and overtime be paid; but that which is the greater will be paid.

In computing road overtime, consideration should be given to the fact that in many cases engine crews are usually on duty from 30 minutes to 45 minutes

longer than train crews. If switch tenders or power switches are not employed, the head brakeman is also called on duty early to handle the switches for the engine in and out of the round house leads.

Several centralized traffic control studies have shown that the initial terminal overtime saving has averaged from 10 to 40 minutes per through freight train.

Final terminal delay is computed from the time the engine reaches a designated point either on the main track or in the yard; however, if road overtime has commenced, terminal overtime does not apply; but, instead, road overtime is paid to the point of final relief.

Initial and final terminal delay time must be checked with agreements of each railroad to obtain basis of payment.

ITEM 2—FUEL

Account 394 does not include cost of on-line fuel transportation. An allowance should be made over the listed cost of train fuel to cover cost of its on-line transportation. For the year 1946 this cost averaged 5.31 mills per net ton mile for Class I railroads in the United States. Each railroad can provide its own cost per ton mile. Also, each railroad has a record of its average length of haul.

ITEM 9—LOCOMOTIVE DEPRECIATION

This item should include charges for depreciation for all road freight locomotives. Reports to the I.C.C. covering these charges are classified as Account 331, Sub-accounts 51 and 52. Annual Report Form A does not provide for separating them between yard and freight locomotives. An item in the same report, Schedule 320, page 307, however, covering charges for "Locomotive Repairs," Accounts 308 and 311, does show a separation between such charges for yard and freight locomotives. The approximate road freight locomotive depreciation can therefore be determined by taking the ratio of "Road Freight Locomotive Repairs" to "Total Freight Locomotive Repairs" and applying it to the "Total Depreciation Charges for Freight Locomotives." While this is an appreciable element of Train Hour Cost, the result thus obtained is considered sufficiently accurate, and to obtain it in any other manner by breaking down the present accounts would not be justified.

Locomotive retirements.

This item was formerly carried as Account 310 but is eliminated from further consideration because the railroads have discontinued accounting under this classification in accordance with latest prescribed I.C.C. rules. Hereafter charges to I.C.C. Account 331, covering Item 9—Locomotive depreciation, will be sufficient to include what was formerly charged under "Locomotive retirements."

ITEM 10—INTEREST ON LOCOMOTIVE INVESTMENT

Investigation of this item indicates that the present practice is to charge only interest on "Locomotive investment" as is currently paid on the Equipment Trust Certificates. Railroad accounting practices do not provide for separation of these charges. The total amount involved for all classes of equipment in each Equipment Trust Certificate is reported in Annual Report Form A. Each

railroad can, of course, separate the amount applicable to road freight locomotives, and the total annual charges for road freight locomotives can thereby be determined. However, since the total annual charge for one representative railroad for 1942 was only \$0.11, this is classified as a minor item, and its value will be omitted from further consideration in this report.

ITEM 11—PAYROLL TAXES

This item should include payroll taxes at the prevailing rate ($6\frac{1}{4}$ per cent in 1948) of all overtime wages for train and enginemen, Item 1, unless included with cost of overtime in Item 1, also labor applicable to Item 6—Enginehouse expenses, and Item 8—Locomotive repairs. The rate for payroll taxes is regulated by Federal law and prescribed to change from time to time, in which event it will, of course, be necessary to change the rate accordingly. The total charges for Item 6 are covered by Account 400, while the total charges for Item 8 are covered by Account 308. These charges are reported in the railroads' Annual Reports Form A without showing separately the cost of labor. It is therefore necessary to separate the labor from the total charges, and while this is more readily obtainable from the railroads' detailed accounts, it can be determined on the basis of assuming the same percentage of labor to total charges shown in Annual Report Form A as has generally prevailed in the past, which is:

- 85 per cent for enginehouse expenses, and
- 70 per cent for road freight locomotive repairs.

ADDITIONAL ITEMS

Costs of double-header, pusher or helper, Diesel and electric propulsion operation are in Items 1 to 11, inclusive, and are not separately shown in Annual Report Form A. Therefore, when it is desired to set up these charges separately or to emphasize what additional expense they may entail, thereby increasing the cost of train hour, it will be necessary that the costs be obtained from the reports of the railroad's particular division where these services are used.

INTANGIBLE ITEMS

Consideration should be given to the following items which, while generally considered intangible, should be evaluated on the basis of local operating conditions:

1. Availability of equipment.
2. Improved service to shippers.
3. Competitive position with other carriers.
4. Value of on-time deliveries, thereby saving penalty of missed market deliveries.

After it has been determined which of the above items are to be considered and the amounts for each have been obtained, the following procedure is necessary to arrive at the Train Hour Value:

1. Total the amounts of Items 1 to and including 11, Table I.
2. The sum of these items to be divided by the amount representing Item A. This result will equal the Train Hour Cost, Item B.
3. To Item B should be added the hourly value of the intangibles to obtain the total Train Hour Value.

The amount of Items 2 to 11, inclusive, is obtainable from Annual Report Form A, as has been explained. For convenience, train hour costs per road freight train hour, Items 2 to 11, have been compiled for the year 1948 by the Bureau of Railway Economics, A.A.R., and are shown in Table II. The table shows system costs for 79 Class I railroads, together with composite average costs for those railroads and average costs by regions.

Inasmuch as the amount of overtime is usually available for individual railroads for the territory involved (but is not shown separately in Report Form A), it has not been included in Table II. If the direct information for overtime is not available, Item I, Table I, should be determined, as has been explained, and added to the sum of Items 2 to 11 to produce complete train hour cost. Payroll taxes for other than train crew wages are included in Item 11, Column 4, Table II.

For those who desire to use cost figures as prepared on system basis for each railroad to represent the value of the train hour saved, Table II will supply the information with Annual Report Form A as the source but without the necessity of the detailed calculations as has been set up in this report.

To simplify Table II, only the total sum for Items 2 through 8 for cost of Fuel, Supplies, Enginehouse Expense and Locomotive Repairs has been shown in Column 2. In order to show the relative value of these various items a breakdown illustrating the costs of each item for Railroad No. 33 listed in Table II for the year 1948 is as follows:

Railroad No. 33

Year 1948

Freight Train Hours (Schedule 531) 1,258,393

Item	Account	Freight proportion (Schedule 320)	Cost per freight train hour
2	394 Train fuel.....	\$17,921,876	\$14.24
3	397 Water for train locomotives.....	721,913	0.57
4	398 Lubricants for train locomotives....	512,374	0.41
5	399 Other supplies for train locomotives	157,230	0.13
6	400 Enginehouse expense—train.....	3,293,584	2.62
7	402 Train supplies and expenses.....	4,875,044	3.87
8	308 Steam locomotive repairs—road		
	freight.....	14,941,420	11.87
	311 Other locomotive repairs—road		
	freight.....	57,064	0.05
Total.....		\$42,480,505	\$33.76

Freight train proportion of costs, Schedule 320, divided by the number of Freight Train Hours, Schedule 531, equals the cost per freight train hour for each of the items. This is the procedure outlined in the Formula in Table I.

TABLE II
Specified Elements of Train Hour Cost
per Road Freight Train Hour—Year 1948
(Excluding road freight train crews' wages)

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense ^a	Total train hour cost (excluding train crew wages)
1	2	3	4	5=2+3+4
Item number in report	Items 2 to 8	Item 9	Item 11	Items 2 to 11
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	\$28.58	\$2.47	\$0.44	\$31.49
2 Boston & Maine.....	25.13	1.00	0.51	26.64
3 Central Vermont.....	27.35	1.05	0.46	28.86
4 Maine Central.....	25.89	0.96	0.48	27.33
5 New York, New Haven & Hartford.....	28.90	1.55	0.56	31.01
6 Rutland.....	27.05	0.75	0.51	28.31
GREAT LAKES REGION:				
7 Grand Trunk Western.....	31.34	1.50	0.45	33.29
8 Erie (Incl. Chgo. & Erie).....	34.49	2.03	0.70	37.22
9 New York, Chicago & St. Louis.....	35.68	0.27	0.64	36.59
10 Delaware & Hudson.....	57.06	1.90	1.28	60.24
11 Delaware, Lackawanna & Western.....	29.40	1.97	0.46	31.83
12 Lehigh & New England.....	16.31	0.95	0.20	17.46
13 Lehigh Valley.....	42.07	2.45	0.68	45.20
14 Monongahela.....	13.19	0.61	0.25	14.05
15 New York, Ontario & Western.....	17.20	2.25	0.38	19.83
16 New York Central (Incl. B. & A.).....	31.01	1.34	0.61	32.96
17 Pittsburgh & Lake Erie.....	43.96	1.73	0.72	46.41
18 Ann Arbor.....	23.23	0.62	0.42	24.27
19 Wabash.....	30.46	1.01	0.53	32.00
CENTRAL EASTERN REGION:				
20 Baltimore & Ohio.....	31.03	0.86	0.67	32.56
21 Bessemer & Lake Erie.....	97.15	4.21	2.64	104.00
22 Chicago & Eastern Illinois.....	26.88	0.92	0.54	28.34
23 Chicago, Indpls. & Louisville.....	24.92	2.44	0.46	27.82
24 Detroit, Toledo & Ironton.....	22.66	1.19	0.30	24.15
25 Elgin, Joliet & Eastern.....	13.31	0.74	0.25	14.30
26 Illinois Terminal.....	11.49	0.93	0.20	12.62
27 Long Island.....	32.08	1.04	0.53	33.65
28 Pennsylvania.....	32.28	1.44	0.61	34.33
29 Cen.R.R. of New Jersey (Incl. C.R.R. of Pa.).....	37.19	1.66	0.65	39.50
30 Reading.....	31.08	1.19	0.63	32.90
31 Western Maryland.....	21.99	2.01	0.79	24.79
32 Wheeling & Lake Erie.....	18.08	0.95	0.32	19.35
POCAHONTAS REGION:				
33 Chesapeake & Ohio (Incl. P. M.).....	33.76	1.39	0.63	35.78
34 Norfolk & Western.....	44.14	1.47	0.85	46.46
35 Richmond, Fred'burg & Potomac.....	50.29	2.65	0.96	53.90
36 Virginian.....	33.8	2.65	0.74	37.24
SOUTHERN REGION:				
37 Atlantic Coast Line.....	23.93	0.72	0.37	25.02
38 Clinchfield.....	38.13	1.72	0.74	40.59
39 Louisville & Nashville.....	25.13	0.52	0.52	26.17
40 Nashville, Chattanooga & St. Louis.....	27.54	0.77	0.59	28.90
41 Florida East Coast.....	36.82	1.46	0.53	38.81

^a Includes freight proportion of charges to operating expense Accounts 392, 393 and 401.

TABLE II—Continued

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense a	Total train hour cost (excluding train crew wages)
1	2	3	4	5=2+3+4
Item number in report	Items 2 to 8	Item 9	Item 11	Items 2 to 11
SOUTHERN REGION—Continued:				
42 Gulf, Mobile & Ohio (Incl. Alton).....	\$27.85	\$4.43	\$0.56	\$32.84
43 Central of Georgia.....	26.72	1.10	0.46	28.28
44 Illinois Central (Incl. Y. & M. V.).....	26.38	1.09	0.48	27.95
45 Norfolk Southern.....	18.66	1.76	0.35	20.77
46 Seaboard Air Line.....	29.62	1.34	0.54	31.50
47 Alabama Great Southern.....	36.05	2.86	0.77	39.68
48 Cincinnati, New Orleans & Tex. Pac.....	34.70	1.95	0.76	37.41
49 Southern.....	27.50	1.35	0.60	29.45
NORTHWESTERN REGION:				
50 Minneapolis, St. Paul & S. Ste. Marie.....	25.79	0.95	0.44	27.18
51 Chicago & North Western.....	26.35	1.47	0.49	28.31
52 Chicago, St. Paul, Mpls. & Omaha.....	22.51	0.84	0.35	23.70
53 Chicago Great Western.....	20.45	1.86	0.24	22.55
54 Chicago, Milwaukee, St. Paul & Pac.....	25.60	0.97	0.42	26.99
55 Duluth, Missabe & Iron Range.....	51.48	0.84	0.91	53.23
56 Great Northern.....	33.83	1.30	0.59	35.72
57 Minneapolis & St. Louis.....	17.65	1.74	0.35	19.74
58 Northern Pacific.....	28.72	1.29	0.57	30.58
59 Spokane, Portland & Seattle.....	24.27	0.91	0.33	25.51
CENTRAL WESTERN REGION:				
60 Atchison, Topeka & Santa Fe.....	35.08	1.04	0.59	36.71
61 Chicago, Burlington & Quincy.....	21.54	1.45	0.30	23.29
62 Colorado & Southern.....	27.53	0.80	0.42	28.75
63 Fort Worth & Denver City.....	28.58	0.70	0.40	29.68
64 Denver & Rio Grande W. (Incl. D. & S. L.)..	39.46	2.01	0.81	42.28
65 Rock Island System.....	25.64	0.93	0.38	26.95
66 Northwestern Pacific.....	16.10	0.29	0.26	16.65
67 Southern Pacific.....	45.35	1.42	0.90	47.67
68 Union Pacific.....	42.65	2.51	0.63	45.79
69 Western Pacific.....	40.92	1.56	0.85	43.33
SOUTHWESTERN REGION:				
70 Frisco Lines.....	29.66	1.22	0.44	31.32
71 Kansas City Southern.....	33.57	2.09	0.54	36.20
72 Louisiana & Arkansas.....	28.97	0.95	0.42	30.34
73 Missouri-Kansas-Texas.....	28.32	1.00	0.43	29.75
74 Gulf Coast Lines.....	25.33	0.87	0.44	26.64
75 International-Great Northern.....	30.68	0.84	0.48	32.00
76 Missouri Pacific.....	25.39	1.18	0.44	27.01
77 Texas & Pacific.....	39.91	1.23	0.63	41.77
78 St. Louis Southwestern.....	30.11	0.88	0.42	31.41
79 Texas & New Orleans.....	32.89	0.61	0.54	34.04
Composite Average.....	31.28	1.31	0.57	33.16

a Includes freight proportion of charges to operating expense Accounts 362, 363 and 401.

TABLE II—Continued

Railroad	Elements of train hour cost (per road freight train hour)			
	Fuel, supplies, enginehouse expense and locomotive repairs	Road freight locomotive depreciation	Payroll taxes on labor applicable to road freight locomotive repairs and enginehouse expense ^a	Total train hour cost (excluding train crew wages)
1	2	3	4	5=2+3+4
Item number in report	Items 2 to 8	Item 9	Item 11	Items 2 to 11
AVERAGES BY REGIONS:				
New England.....	27.11	1.30	0.51	28.92
Great Lakes.....	32.72	1.40	0.62	34.74
Central Eastern.....	30.70	1.27	0.62	32.59
Pocahontas.....	37.17	1.54	0.71	39.42
Southern.....	27.04	1.20	0.52	28.76
Northwestern.....	27.67	1.21	0.48	29.36
Central Western.....	35.90	1.47	0.61	37.98
Southwestern.....	29.84	1.05	0.47	31.36

^a Includes freight proportion of charges to operating expense Accounts 392, 393 and 401.

Action Recommended

Acceptance as information.

ECONOMICS OF COMMUNICATION BETWEEN FRONT AND REAR END AND BETWEEN ENGINES, TRAINS AND FIXED POINTS*

Pennsylvania R.R.

Since report presented in 1946**, there have been appreciable increases in the installation of inductive trainphone equipment on the Pennsylvania R.R. The initial installation on the Belvidere Delaware Branch, mentioned in that report, proved to be so satisfactory that it has been extended to the freight and passenger service on the main line of the Middle Division, freight service over the Petersburg Branch of the Middle Division, Sandusky Branch of the Toledo Division, passenger service on the Pittsburgh Division, and on all through Diesel road locomotives for freight and passenger service operating between Harrisburg, Pa. and Chicago, Ill., St. Louis, Mo., Cincinnati, Ohio, and Detroit, Mich. An installation is now being made for freight service on the Maryland and Williamsport Divisions between Baltimore, Md., Harrisburg, Pa., Williamsport, Pa., and Elmira, N. Y., also over the Bald Eagle Branch of the Middle Division.

The statistics for these different installations are shown in Table I. Figure 1 graphically shows the location of the installations.

* A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 38 and 508.

** A.A.R. Signal Section 1945 Proceedings, Vol. XLIII, pp. 47 and 291.

TABLE I

	Block stations	Miles of road	No. of main tracks	Block system	Frt. trains daily	Psg. trains daily
Trenton—Phillipsburg, Pa.						
New Jersey Branch.....	2	50	1-2	Manual	10-12	2
Harrisburg—Pittsburgh, Pa.						
Main Line.....	35	246	4	Auto. block and cab signal	65-70	65-75
Petersburg Branch.....	2	39	2	Manual	10-12	0
Columbus—Sandusky, Ohio.....	10	104	1-2	Manual	20-30	0
Baltimore, Md.—Elmira, N. Y.....	9	254	1-2	Auto. block and manual	30-35	5-15
Bald Eagle Branch.....	1	54	2	C. T. C.	10	2
Total.....	59	747				

Locomotives and Cabin Cars Trainphone Equipped

Diesel-electric.....	203
Steam.....	288
Cabin cars.....	130
Total.....	621

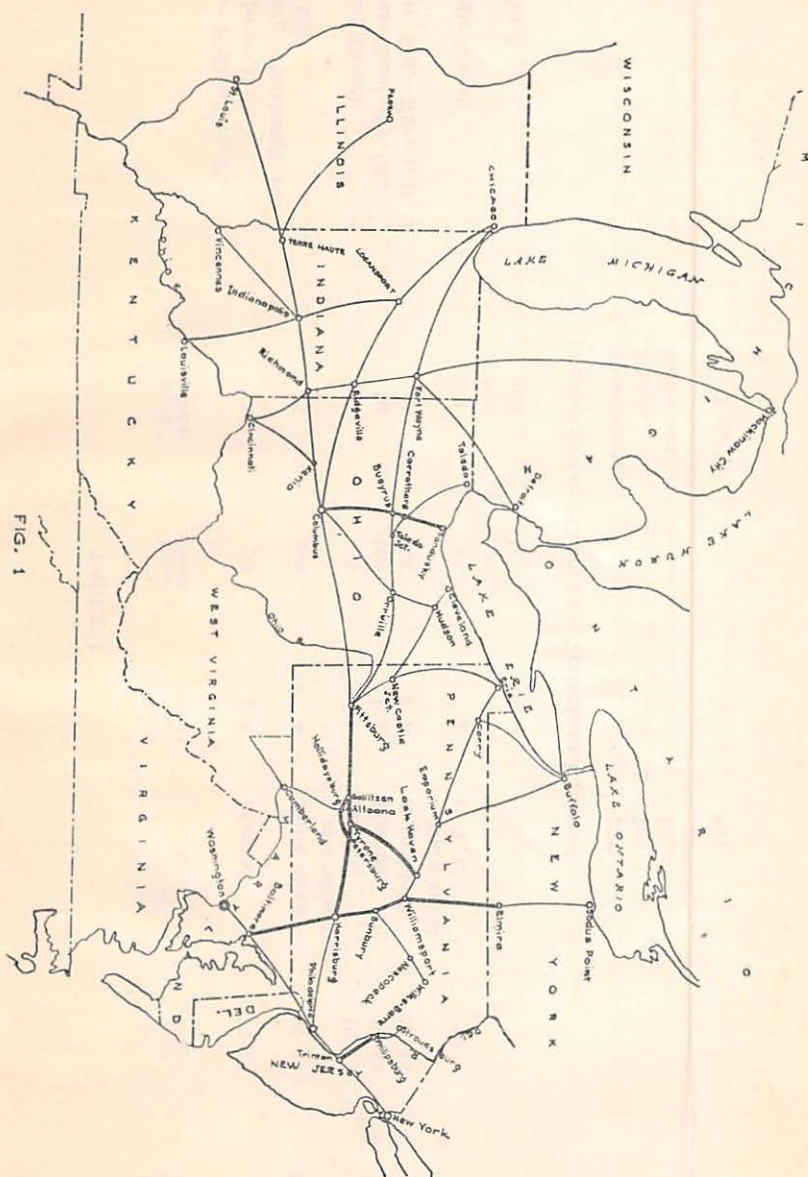


FIG. 1

Description of the system, which appeared in the 1946 report, is practically correct, except that the system now operates on 80 and 144 kilocycles. The power supply on cabin cars is now provided by an axle-generator and 32-volt storage battery.

Reference was made in the 1946 report to the use of calling signals sent out by the operation of a calling lever on the control station. This has been discontinued, the calling now being exclusively by use of the loud-speaker associated with each station, except for emergency calls.

The Diesel road engines in freight and passenger service are operated through from Harrisburg, Pa. to Chicago, Ill., St. Louis, Mo., Cincinnati, Ohio and Detroit, Mich. and these mileages west of Pittsburgh, Pa. are not shown in the tabulation.

Based on a 3-day check on the use of the trainphone in October 1948, the following shows tangible benefits from its use in saving in train hours per day:

	Hours	Minutes
Belvidere Delaware Branch.....	5	30
Middle Division.....	36	51
Pittsburgh Division.....	6	57
Sandusky Branch (incomplete reports).....	0	37
All others.....	2	5
Total train hours daily.....		52

Intangible benefits from the use of the trainphone were secured from 551 calls made daily by block stations, freight and passenger trains, as shown in the following tabulation:

	Total calls (daily)	Better train movements (daily)
Belvidere Delaware Branch.....	41	16
Middle Division.....	275	175
Pittsburgh Division.....	129	54
Sandusky Branch (incomplete reports).....	8	4
Panhandle Division.....	40	10
All others.....	58	1
Total.....	551	260

Each of the calls was made in the interest of better train operations. They related to abnormal conditions on Pennsylvania R.R. trains and engines, other trains and engines, track conditions and to operations of trains involved. Prompt reporting of abnormal conditions when seen and notification of same to trains involved or to block stations permitted correction of numerous potential causes for delays, with resultant improvement of service.

The system has been found to be very helpful in train operation during periods of heavy fog or storm when it was impossible to transmit hand signals between head and rear ends of long freight trains, in reporting the condition of trains met or passed on adjacent tracks in case of irregularities in equipment

on the other train, and in securing help in event of engine trouble developing enroute. It keeps the train dispatcher advised, through the block operators, of train conditions and locations, and thus enables him more efficiently to arrange his train movements.

It has been found that the more familiar the train crews and block operators become with this equipment, the more they use it, the more promptly they answer their calls and the greater benefits are secured from its use in improved train operation.

Action Recommended

Acceptance as information.

INSTALLATIONS OF TRAIN OPERATION BY SIGNAL INDICATION* WITHOUT TRAIN ORDERS, IN THE UNITED STATES JANUARY 1, 1949†

Methods of operating trains	No. of railroads	Miles of Road	Track
One-direction operation by signal indication:			
(a) Centralized traffic control.....	8	164.8	287.7
(b) Manual block.....	15	1,719.8	2,478.4
(c) Controlled manual block.....	2	7.7	9.5
(d) Automatic block.....	60	12,648.5	28,773.0
Either-direction operation by signal indication:			
(e) Centralized traffic control.....	63	9,994.2	10,969.5
(f) Controlled manual block.....	12	189.7	194.5
(g) Automatic block in both directions.....	54	2,732.0	3,576.4
(h) Automatic block in one direction, traffic locking, reverse direction.....	23	242.1	473.9
Total reported by 102 railroads.....		27,698.8	46,762.9

Action Recommended

Acceptance as information.

* I.C.C. Tabulation of Statistics, Table No. 8.

† Revision of Table IX appearing on page 43 of Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices. Previous report appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 37 and 467.

**TRAIN COMMUNICATION SYSTEMS—LINE OF ROAD
INSTALLATIONS IN SERVICE JANUARY 1, 1949***

Number of railroads.....	22
Number of installations.....	38
Miles of road.....	17,159
Type of systems:	
(a) Radio.....	19
(b) Inductive.....	11
(c) Wire intercommunication system.....	6
(d) Commercial telephone company mobile radio service.....	4
Type of service:	
(a) Wayside-to-train.....	17
(b) End-to-end and train-to-train.....	31
(c) Public telephone service.....	4
Number of units equipped:	
(a) Wayside stations.....	173
(b) Locomotives.....	746
(c) Cabooses.....	287
(d) Other mobile.....	35
(e) Portable pack sets.....	2

Action Recommended

Acceptance as information.

* I.C.C. Tabulation of Statistics, Table No. 11-A.

(New table for inclusion in Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices.)

INTERLOCKINGS IN THE UNITED STATES*,
JANUARY 1, 1949†

Interlockings on line of reporting railroad.....	6,748
Interlockings maintained by reporting railroad.....	4,511
Railroads reporting.....	222
Automatic.....	456
Electric.....	1,682
Electro-mechanical.....	392
Electro-pneumatic.....	452
Mechanical.....	1,451
Pneumatic.....	4
Other types.....	74
Total.....	4,511
Remotely controlled.....	640

Action Recommended

Acceptance as information.

* I.C.C. Tabulation of Statistics, Table No. 6.

† Revision of Table V appearing on page 31 of Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices. Previous report appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 40 and 467.

RAILROAD-HIGHWAY GRADE CROSSINGS—NUMBER OF
CROSSINGS EQUIPPED, TYPES OF PROTECTION,
AND NUMBER OF UNPROTECTED CROSSINGS
IN THE UNITED STATES*,
DECEMBER 31, 1947 and 1948†

	Number 1947	1948
Gates, with or without other protection operated 24 hours per day.....	3,308	3,530
Gates, with or without other protection operated less than 24 hours per day.....	991	925
	4,299	4,455
Watchmen, alone or with protection other than gates, on duty 24 hours per day.....	1,277	1,231
Watchmen, alone or with protection other than gates, on duty less than 24 hours per day.....	3,098	2,912
	4,375	4,143
Both audible and visible signals, without other protection.....	12,907	13,426
Audible signals only.....	2,511	2,400
Visible signals only.....	9,697	10,083
	25,115	25,909
Total protected crossings.....	33,789	34,507
Fixed signs.....	183,650	183,515
Otherwise unprotected.....	9,062	8,822
Grand total.....	226,501	226,844

Action Recommended

Acceptance as information.

* I.C.C. "Statistics of Railways in the United States."

† Revision of Tables XX and XXI appearing on pages 75 and 76 of Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices. Previous report appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 44, 45 and 509.

SPRING SWITCHES IN SERVICE IN THE UNITED STATES
AS OF JANUARY 1, 1949*

Classification as to territory:

Automatic block.....	4,560
Manual block.....	236
Centralized traffic control.....	161
Non-block.....	909
Interlocking.....	182
Yard.....	573
Total.....	6,621

Classification as to application:

End of siding.....	4,275
End of two tracks.....	614
Junction.....	239
Yard tracks.....	841
Other tracks.....	652
Total.....	6,621

Number equipped with:

Facing point locks.....	1,788
Electric locks.....	20
Total.....	1,808

Number of protecting signals:

High signals.....	9,356
Low signals.....	3,324
Total.....	12,680

Action Recommended

Acceptance as information.

* I.C.C. Tabulation of Statistics, Table No. 10.

(New table for inclusion in Chapter III—Principles and Economics of Signaling, American Railway Signaling Principles and Practices. Previous report appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 46 and 510.)

TRACK AND ROADWAY MAINTENANCE EXPENSES—
PER EQUATED TRACK MILE

Annual saving in operating expenses, due to retirement of track, switches, and other track appliances, varies with local conditions on each project.

In its investigation of this assignment, the Committee, through cooperation with the Bureau of Railway Economics, A.A.R., has secured information showing track and roadway maintenance expenses per equated track mile (running tracks) and traffic density, on each of 79 railroads for the year 1948, as shown in Table I. This data was developed from Annual Report Form A of each railroad.

The term, "equated track miles," shown in Column 1 of Table I, for each railroad, is based on a weight of 100 for first main track and 80 for additional main track, passing tracks, crossovers and turnouts operated following A.R.E.A. practice but excluding way and yard switching tracks. The mileage operated under trackage rights is excluded.

The track and roadway maintenance expenses per equated track mile shown for each railroad includes only charges to operating expense for maintenance of running tracks, Accounts Nos. 202, 208, 212, 214, 216, 218, 220, and total charges, Accounts Nos. 269, 270, 271, 272 and 274. Charges to accounts not affected by the elimination or the change in classification of a track have been omitted.

The amount shown per equated track mile represents equivalent expense for one mile of first main track. Expense per mile of additional main track and per mile of passing tracks may be computed as 80 per cent of this amount.

As traffic density, *i.e.*, gross ton miles per mile of road, is an important factor in rail renewal, the last column of Table I shows the tonnage data for each railroad. It represents gross ton miles, including locomotive and tender, for freight and passenger service mile of first main track.

The track and roadway maintenance expense per equated track mile varies from a minimum of \$1,199 to a maximum of \$8,678 with a composite average of \$2,926 for the 79 railroads.

Where signaling improvements result in track retirements, and the estimated saving in operating expenses cannot be obtained on a project, the information shown in Table I may help in arriving at an estimated saving per year.

TABLE I
Track and Roadway Maintenance Expenses per Equated
Track Mile (Running Tracks) and Traffic Density
Calendar Year 1948

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
NEW ENGLAND REGION:				
1 Bangor & Aroostook.....	660.71	\$1,781,535	\$2,696	3,058
2 Boston & Maine.....	2,294.67	8,129,302	3,543	7,468
3 Central Vermont.....	394.99	990,645	2,508	4,368
4 Maine Central.....	1,070.24	2,981,957	2,786	3,954
5 New York, New Haven & Hartford.....	2,531.50	11,172,715	4,413	10,806
6 Rutland.....	438.39	525,847	1,199	2,884
GREAT LAKES REGION:				
7 Grand Trunk Western.....	1,292.20	4,271,340	3,305	9,407
8 Erie (Incl. Chgo. & Erie).....	3,354.62	11,219,994	3,345	15,314
9 New York, Chicago & St. Louis.....	2,045.15	7,885,155	3,856	13,703
10 Delaware & Hudson.....	1,002.12	3,959,071	3,951	16,426
11 Delaware, Lackawanna & Western.....	1,005.44	5,735,844	5,705	15,212
12 Lehigh & New England.....	185.25	587,687	3,172	5,206
13 Lehigh Valley.....	1,784.71	5,733,755	3,213	10,734
14 Monongahela.....	198.58	489,632	2,466	7,938
15 New York, Ontario & Western.....	534.53	752,250	1,407	2,711
16 New York Central (Incl. B. & A.).....	15,077.29	55,645,524	3,691	14,374
17 Pittsburgh & Lake Erie.....	381.57	3,089,057	8,096	21,894
18 Ann Arbor.....	320.60	674,649	2,104	5,486
19 Wabash.....	2,554.21	7,674,642	3,005	9,420
CENTRAL EASTERN REGION:				
20 Baltimore & Ohio.....	7,900.22	29,364,950	3,717	13,051
21 Bessemer & Lake Erie.....	334.31	1,080,563	3,232	21,057
22 Chicago & Eastern Illinois.....	991.10	2,117,198	2,136	7,069
23 Chicago, Indianapolis & Louisville.....	567.38	1,834,670	3,234	6,014
24 Detroit, Toledo & Ironton.....	476.73	907,718	1,904	4,239
25 Elgin, Joliet & Eastern.....	279.72	1,213,607	4,339	15,193
26 Illinois Terminal.....	507.07	1,021,584	2,015	2,525
27 Long Island.....	593.97	3,917,412	6,595	10,081
28 Pennsylvania.....	14,864.58	56,853,720	3,825	18,353
29 Cen.R.R. of New Jersey (Incl. C.R.R. of Pa.).....	843.98	3,716,036	4,403	12,055
30 Reading.....	2,156.58	9,843,386	4,564	14,091
31 Western Maryland.....	878.27	3,149,022	3,585	10,208
32 Wheeling & Lake Erie.....	556.10	2,625,512	4,721	10,466
POCAHONTAS REGION:				
33 Chesapeake & Ohio (Incl. Pere M.).....	5,696.70	27,144,526	4,765	15,846
34 Norfolk & Western.....	2,973.99	13,081,752	4,399	21,928
35 Richmond, Fred'burg & Potomac.....	239.62	2,079,338	8,678	41,795
36 Virginian.....	720.43	2,382,420	3,307	14,168
SOUTHERN REGION:				
37 Atlantic Coast Line.....	6,374.54	18,662,174	2,928	5,829
38 Clinchfield.....	329.53	1,276,295	3,873	12,951
39 Louisville & Nashville.....	5,604.94	15,712,363	2,893	9,581
40 Nashville, Chattanooga & St. Louis.....	1,208.31	3,515,554	2,909	6,859
41 Florida East Coast.....	948.30	2,679,928	2,826	10,265
42 Gulf, Mobile & Ohio (Incl. Alton).....	3,012.03	9,015,490	2,993	5,593
43 Central of Georgia.....	1,927.48	3,615,526	1,876	4,746
44 Illinois Central (Incl. Y. & M. V.).....	7,925.92	24,291,504	3,065	8,817
45 Norfolk Southern.....	748.30	1,422,867	1,901	2,280
46 Seaboard Air Line.....	4,633.66	13,456,744	2,904	7,061
47 Alabama Great Southern.....	409.43	1,601,079	3,911	12,478
48 Cincinnati, New Orleans & Tex. Pac.....	582.90	3,078,452	5,281	25,718
49 Southern.....	7,135.77	19,959,769	2,797	7,450

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to operating expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272, and 274.

c Represents equivalent expense for one mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

TABLE I—Continued

Railroad	Equated track miles (running tracks) a	Track and roadway maintenance expenses		Gross ton-miles per mile of road (traffic density) d (000)
		Total b	Per equated track mile c	
NORTHWESTERN REGION:				
50 Minneapolis, St. Paul & S. Ste. Marie.....	4,355.79	\$7,293,547	\$1,674	3,232
51 Chicago & North Western.....	9,182.91	17,551,637	1,911	4,962
52 Chicago, St. Paul, Mpls. & Omaha.....	1,813.74	3,056,963	1,685	4,153
53 Chicago Great Western.....	1,532.29	3,395,105	2,216	5,885
54 Chicago, Milwaukee, St. Paul & Pac.....	11,494.78	21,002,428	1,827	5,071
55 Duluth, Missabe & Iron Range.....	757.23	3,208,224	4,237	12,537
56 Great Northern.....	8,850.25	22,846,634	2,581	5,682
57 Minneapolis & St. Louis.....	1,382.34	2,179,533	1,577	2,759
58 Northern Pacific.....	7,744.16	16,121,623	2,082	5,294
59 Spokane, Portland & Seattle.....	1,029.42	4,153,840	4,035	5,857
CENTRAL WESTERN REGION:				
60 Atchison, Topeka & Santa Fe.....	15,790.02	45,987,857	2,912	9,760
61 Chicago, Burlington & Quincy.....	9,798.18	20,826,616	2,126	6,686
62 Colorado & Southern.....	661.19	1,004,148	1,519	4,141
63 Fort Worth & Denver City.....	906.45	1,468,501	1,620	3,780
64 Denver & Rio Grande W. (Incl. D. & S.).....	2,704.39	4,981,721	1,842	6,183
65 Rock Island System.....	8,136.40	14,089,872	1,732	5,861
66 Northwestern Pacific.....	369.21	1,165,988	3,158	4,099
67 Southern Pacific.....	9,536.89	31,310,465	3,283	12,640
68 Union Pacific.....	11,556.44	37,181,676	3,217	10,923
69 Western Pacific.....	1,265.76	4,030,766	3,184	8,329
SOUTHWESTERN REGION:				
70 Frisco Lines.....	5,304.37	11,250,772	2,121	5,563
71 Kansas City Southern.....	980.21	2,168,755	2,213	10,306
72 Louisiana & Arkansas.....	702.80	1,664,613	2,369	4,846
73 Missouri-Kansas-Texas.....	3,354.87	6,796,851	2,026	5,911
74 Gulf Coast Lines.....	1,246.64	4,403,636	3,532	5,936
75 International-Great Northern.....	1,157.93	3,748,534	3,237	6,839
76 Missouri Pacific.....	7,599.84	21,100,268	2,776	7,725
77 Texas & Pacific.....	2,099.99	6,359,888	3,029	10,108
78 St. Louis Southwestern.....	1,556.61	4,242,558	2,726	8,731
79 Texas & New Orleans.....	4,630.15	10,645,157	2,299	6,528
Composite Average.....	256,049.88	749,159,916	2,926	8,986
AVERAGES BY REGIONS:				
New England.....	7,390.50	25,582,001	3,461	6,919
Great Lakes.....	29,736.27	107,718,600	3,622	13,139
Central Eastern.....	30,950.01	117,645,378	3,801	14,522
Pocahontas.....	9,630.74	44,688,036	4,640	17,705
Southern.....	40,841.11	118,287,745	2,896	7,594
Northwestern.....	48,142.91	100,809,534	2,094	5,061
Central Western.....	60,724.93	162,047,610	2,669	8,938
Southwestern.....	28,633.41	72,381,012	2,528	7,033

a Based on a weight of 100 for first main track, 80 for additional main track, passing tracks, crossovers, and turnouts operated; mileage operated under trackage rights is excluded.

b Includes charges for maintenance of running tracks to operating expense Accounts 202, 208, 212, 214, 216, 218, 220, and total charges to Accounts 269, 270, 271, 272, and 274.

c Represents equivalent expense for one mile of first main track. Expense per mile of additional main track, passing tracks, crossovers, and turnouts may be computed as 80 per cent of this amount.

d Represents gross ton-miles (including locomotive and tender) freight and passenger service per mile of first main track.

Action Recommended

Acceptance as information.

OPERATING ADVANTAGES OF INTERLOCKING INSTALLATIONS AT LINDEN, ROACHDALE AND GOSPORT JUNCTION, IND., ON THE CHICAGO, INDIANAPOLIS & LOUISVILLE RY.

During 1947 and 1948, the Chicago, Indianapolis & Louisville Ry. installed three interlockings at former non-protected single-track railroad grade crossings. Trains on the Monon adjacent to these crossings were governed by automatic block signals and train orders and on the crossing lines by manual block and train orders. The trains of all the railroads involved were required by law to stop at the non-protected railroad grade crossings. There was no change in personnel.

Some of the important details of the three interlockings are as follows:

Station	Miles from Chicago	Other railroads involved	Type interlocking	C. I. & L. Ry. Avg. trains daily		
				Psg.	Frt.	Total
Linden.....	137.0	N.Y.C.&St.L.	Attended	4	8	12
Roachdale.....	162.2	B.&O.	Attended	4	6	10
Gosport Junction.....	203.1	P.R.R.	Automatic	4	6	10

The Monon traffic was based on a train count in July 1949, with lighter traffic per day than in 1947 when Gosport Junction interlocking was installed, and in 1948 when the other two interlockings were installed.

Based on a study made by the Monon for the month of July 1949, the estimated saving at each interlocking included 5 minutes for each of the third class (local) freights, 10 minutes for the second class (time) freights, and the train stops saved by the first, second and third class trains. No time saving was included for the first class passenger trains.

Gosport Junction

Based on this estimate, the details of the estimated saving per year for Gosport Junction interlocking, as an example, were as follows:

Freight train time saved per month:

124 second class freight trains @ 10 minutes.....	1,240 minutes
52 third class freight trains @ 5 minutes.....	260 minutes
Total.....	1,500 minutes

$(1,500 \div 60) \times 12 = 300$ hours saved per year

$300 \times \$27.82$ (Train hour cost, C. I. & L. Ry. 1948)..... \$8,346

Train stop saving per month:

No. of stops	Cost per stop	
124 second class freight trains @ \$1.50.....		\$186
52 third class freight trains @ 1.00.....		52
124 passenger trains @ 0.50.....		62
Total.....		\$300

Train stop saving per year— $12 \times \$300$ 3,600

Total gross saving..... \$11,946

Economic Statement

1. Cost of Installation:	
(a) Capital Investment.....	\$13,500
(b) Total.....	\$13,500
2. Gross Saving per Annum.....	\$11,946
3. Increased Annual Operating Expenses:	
(a) Signal maintenance and operation.....	\$471
(b) Depreciation @ 3% (of 1-a).....	405
(c) Total.....	876
4. Net Reduction in Annual Operating Expenses.....	\$11,070
5. Deduction for Interest Charges @ 4% (of 1-a).....	540
6. Net Saving per Annum.....	\$10,530
7. Annual Return over 4% Interest:	
(a) On Capital Investment ($6 \div 1-a$).....	78.0%

A summary of the saving to the Monon at the three interlockings is as follows:

Station	Frt. train hours saved per year	Total stops saved per year	C. I. & L. Ry. R&E cost	Estimated annual saving	Per cent return on R&E
Linden.....	426	4,344	\$12,000	\$15,361	128.0
Roachdale.....	300	3,600	22,500	9,696	43.1
Gospport Junction	300	3,600	13,500	10,530	78.0
	1,026	11,544	\$48,000	\$35,587	74.1 Avg.

Summary

The three interlocking installations are estimated to save the Monon 1,026 freight train hours and 11,544 train stops amounting to \$35,587 annually, with a return on R&E cost varying from 43.1 to 128 per cent, or sufficient to pay for the installations in less than 2 years. In addition, the safety of train operation was increased.

Action Recommended

Acceptance as information.

ECONOMICS OF SIDINGS IN CENTRALIZED TRAFFIC
CONTROL TERRITORY AS EFFECTED BY SIDING
USAGE, SIDING LENGTH AND SIZE OF TURNOUT

A discussion of sidings in centralized traffic control territory usually involves their use per day, their length, and the size of turnouts. These factors must be given consideration in developing a proposed plan for centralized traffic control operation as these factors affect the cost of installation, the annual cost of maintenance and operation, and the return on the investment.

The experience of the past 20 years has shown that fewer sidings are necessary with centralized traffic control operation than with the previous methods of directing train movements. This reduction in the number of sidings was often due to the inadequacy of the former sidings to suit modern railroad operation with heavier motive power and longer freight trains operated at increased speeds, but more especially because of the reduced running time occasioned by elimination of hand throwing of siding switches and reduction in the number of meets and passes account accelerated movement through the territory.

It is proposed in this report to cover some of the details of this assignment and, in a future report, include examples illustrating the various factors involved in siding usage, siding length, siding spacing and size of turnout.

Siding usage.

In making signal studies, one of the first problems, after determining the test period for train sheet study, is to make an analysis of the siding usage. This analysis usually shows that some sidings, due to local conditions, were used more frequently than other sidings, some sidings were used several times daily at regular meeting and passing points, others were used infrequently, except by local freights or trains picking up and setting out, and some were not used at all during the days being studied.

Having obtained the siding usage for the test period, information is then obtained from the dispatcher and local officials relative to their views on the siding usage and siding spacing. In order to provide an economical track and signal plan, it is desirable to eliminate sidings which are not used, are used infrequently, do not fit into the future development of the railroad, or cannot be economically justified for railroad operation. On this same basis, it is desirable to check all other switches in main track.

The use of a siding for regular meets and passes averaging less than one per day may be due to:

1. Length of siding.
2. Location on grade or curves.
3. Location in respect to adjacent sidings.
4. Distribution of traffic in 24 hours.
5. Use primarily by local freights.
6. Local conditions.

The forecasted use of all sidings under centralized traffic control operation is obtained from the redispached train charts and used as a basis for further discussion. The elimination of sidings and switches in main track should be analyzed on the basis of the local operating condition on each signal project.

Estimated signaling cost for control of a siding in centralized traffic control territory.

The cost of equipping a siding in centralized traffic control territory with two power switches and six signals varies, depending upon the local requirements, on each railroad. Traffic conditions, standards of construction, track changes, high or low tension power lines, etc., vary on each project and account for a wide range in costs.

Table I shows how the annual cost of maintenance and operation varies with four estimated costs per siding.

TABLE I

Estimated Annual Cost of Signaling a Controlled
Siding in Centralized Traffic Control Territory
at Various Costs per Siding

Annual cost of maintenance and operation	Cost per siding at			
	\$25,000	\$30,000	\$35,000	\$40,000
1. Interest at 4 per cent.....	\$1,000	\$1,200	\$1,400	\$1,600
2. Depreciation at 3 per cent.....	750	900	1,050	1,200
3. Maintenance and operation at 3 per cent.....	750	900	1,050	1,200
4. Total annual cost.....	\$2,500	\$3,000	\$3,500	\$4,000
5. Total cost per day.....	\$6.85	\$8.22	\$9.59	\$10.96

Table I is based on typical siding costs varying from \$25,000 to \$40,000, depending on local operating requirements, in 1949. The percentages shown will vary in accordance with railroad practice.

The estimated cost per siding should be the difference in cost between the proposed centralized traffic control layout at a siding, if the siding is left in service, as compared with the signaling cost if the siding is entirely eliminated or left in service to expedite switching operations. If left in service and electric locked, the difference in cost will be less than if the siding is removed. Another factor may be the use of additional intermediate automatic signals at or near the siding location if the siding is removed. Each railroad should apply the costs involved on a project under study.

For the cases shown, a train stop saving or road freight train time saving of \$6.85 to \$10.96 per day would economically justify a centralized traffic controlled siding.

A comparison of the siding usage on many centralized traffic control studies has shown that some sidings, with train order and forecasted centralized traffic control operation, are used less than an average of once per day for meets and passes. Based on saving two train stops per day, with centralized traffic control, it has been the general practice to assume that the saving was sufficient to justify the maintenance and operation cost of the two power switches and the signaling at the ends of the siding.

As the cost saved per stop is an important factor in an economic comparison, Table II has been prepared to show how the annual savings vary with the cost per stop on various railroads.

TABLE II
Annual Saving from Train Stops at Various Costs per Stop

No. of stops saved daily	Cost per stop at							
	\$0.50	\$1.00	\$1.50	\$2.00	\$2.50	\$3.00	\$3.50	\$4.00
1	\$ 183	\$ 365	\$ 548	\$ 730	\$ 913	\$ 1,095	\$ 1,278	\$ 1,460
2	365	730	1,095	1,460	1,825	2,190	2,555	2,920
3	548	1,095	1,643	2,190	2,738	3,285	3,833	4,380
4	730	1,460	2,190	2,920	3,650	4,380	5,110	5,840
5	913	1,825	2,738	3,650	4,563	5,475	6,388	7,300
6	1,095	2,190	3,285	4,380	5,475	6,570	7,665	8,760
7	1,278	2,555	3,833	5,110	6,388	7,665	8,943	10,220
8	1,460	2,920	4,380	5,840	7,300	8,760	10,220	11,680
9	1,643	3,285	4,928	6,570	8,213	9,855	11,498	13,140
10	1,825	3,650	5,475	7,300	9,125	10,950	12,775	14,600

Note.—Often, several values for train stops saved are used on a centralized traffic control project, depending upon the class of train involved.

The values used for freight train stops in recent years have increased due to the use of heavier motive power and increased tonnage.

Using the annual saving shown in Table II, Table III has been prepared to show the required number of train stops to be saved daily to justify the total annual cost of maintaining and operating a controlled siding in centralized traffic control territory.

TABLE III
Approximate Number of Stops Required to be Saved Daily to Justify
Total Annual Signaling Cost of Controlled Siding in
Centralized Traffic Control Territory

Total daily cost mtn. and opn.	Number of stops required to be saved at cost per stop							
	\$0.50	\$1.00	\$1.50	\$2.00	\$2.50	\$3.00	\$3.50	\$4.00
\$ 6.85	14	7	5	4	3	3	2	2
8.22	17	9	6	5	4	3	3	3
9.59	20	10	7	5	4	4	3	3
10.96	22	11	8	6	5	4	4	3

Using the maintenance and operation costs developed in Tables I and II, Table III shows that approximately 2 to 22 stops must be saved daily to economically justify a controlled siding, based on the factors used in this report.

Another factor in siding usage is the road freight time saved by use of the siding equipped with power switches and controlled signals.

TABLE IV
Road Freight Time Saving Required to Justify Controlled Siding

Total cost mtn. and opn. per day	Minutes required to be saved daily at train hour cost* (1947)				
	Railroad A	Railroad B	Railroad C	Railroad D	Railroad E
\$ 6.85	22	18	14	13	10
8.22	26	21	17	15	12
9.59	31	25	20	17	14
10.96	35	28	22	20	16

Note.—For this report, the train hour cost per minute for each railroad was as follows:

A—\$0.314

B—\$0.396

C—\$0.501

D—\$0.566

E—\$0.686

The minutes required to be saved are derived by dividing the total cost of maintenance and operation per day by the train hour cost per minute.

Table IV shows that a daily time saving of 10 to 35 minutes is required to justify the controlled siding, depending upon the train hour cost for the railroad involved.

If Railroad A saves 22 minutes daily by the use of a siding, it would justify the annual maintenance and operation expense necessary to justify an expense of \$25,000 for a controlled siding without any additional saving for the train stops saved. Railroad E could justify the same expense by saving 10 minutes daily. A smaller daily time saving in each case would not economically justify the siding.

The cost factors used in Tables I to IV are typical and should be varied to suit the requirements of each railroad.

Siding length.

The general adoption in recent years of heavier motive power for operation of longer and increased tonnage freight trains at higher speeds has resulted in siding extensions being made to reduce delays, expedite traffic, increase operating efficiency and meet competitive conditions.

A short siding, say 57 cars or 3,200 feet in length from point of switch to point of switch and where the average train length is 70 to 90 cars, has several operating disadvantages in centralized traffic control territory, some of which are as follows:

1. It is too short for use except by short trains, including passenger and local trains.
2. The 3,200-foot spacing between signals is less than stopping distance for Approach signals, necessitating either successive "yellow" signals or additional indications at an increased signal expense with resulting loss of road time and operating facility.

* A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, p. 34.

3. The location of centralized traffic control signals back of the clearance point and the substitution of a longer turnout would have the effect of reducing the siding capacity as much as 8 or 10 cars, and materially reduces its usefulness for meeting and passing trains.

4. May result in "Saw-Bys" with resulting delays to trains.

5. The short siding requires slower speed on main track while entering siding.

A 100-car siding*, say 6,700 feet in length, has the following advantages:

1. Can be used by all trains for meets and passes without "Saw-Bys," with increased facility of train operation.

2. It may provide proper spacing between signals for Approach indications without successive "yellow" signal indications, thereby reducing the signal cost.

3. The longer siding allows some margin for increased train length as the average length of freight train increases.

4. Provides sufficient length for longer turnouts when installed.

5. Permits higher speed on main track while entering siding and on siding.

6. Shortens the distance to the adjacent siding.

7. Longer siding may hold two short trains when required.

8. Longer siding will permit more non-stop meets.

9. It fits into the future development of the railroad.

The economics of the siding extension of 3,500 feet (6700-3200) will depend on the cost of the siding extension, the cost of the additional track maintenance and the interest on the investment. The total annual cost is then reduced to a cost per day. The estimated time saving per day due to the siding extension should equal or exceed the annual cost of the track extension in order to justify its operation.

Size of turnout.

Many single-track centralized traffic control projects with power-operated switches include increased size of turnouts at ends of sidings, ends of second track and at crossover locations with signal indication operation as compared to the previous train order operation.

Some of the factors involved in the adoption of longer turnouts are as follows:

1. To meet modern track standards demanded by increased weight of rail.

2. To save time at meeting and passing points by permitting higher speeds over turnouts in entering and leaving sidings and at crossovers.

3. To permit easier riding of passenger trains and smoother handling of freight trains through the turnouts at authorized speeds.

4. To expedite freight and passenger train operation to meet competitive traffic conditions.

The general centralized traffic control practice has been to increase the size of the turnout from No. 10 to No. 14, 15, 16 or 20.

A No. 10 turnout, at an end of siding, for instance, was satisfactory at a hand-operated switch in automatic block signal territory, as the train entered the siding at a speed of 4 to 8 miles per hour either after stopping at the switch or moving at slow speed.

* For complete report and examples based on 90, 100, 125 and 150 cars, see A.A.R. Signal Section 1946 Proceedings, Vol. XLIV, p. 42-A.

The adoption of centralized traffic control with power-operated switches has eliminated stops for entering and leaving sidings and has permitted a speed of 15 to 30 miles per hour depending upon the size of the turnout, the signal indications displayed, and the local speed restrictions.

Conclusions.

1. The factors used in this report are typical and should be varied to suit the requirements of each railroad.

2. While this report refers to single-track centralized traffic control operation, it also applies to other signal projects like interlocking, remote control of outlying switches, signal indication operation on two or more tracks, etc.

3. Siding usage, siding length, siding spacing and size of turnout, are factors to be considered in developing a proposed plan for centralized traffic control operation.

4. The train stops saved and the freight train time saved daily, and the values placed on the train stops, and train hour value, will determine the economics of the centralized traffic control installation.

Action Recommended

Acceptance as information.

ECONOMICS OF ROUTE LOCKING WITH SECTIONAL RELEASE ON POWER-OPERATED SWITCHES IN CENTRALIZED TRAFFIC CONTROL TERRITORY ON THE DENVER & RIO GRANDE WESTERN R.R.

In the 290-mile continuous centralized traffic control installation from Gypsum, Colo. to Helper, Utah, on the Denver & Rio Grande Western R.R., there were numerous exceptions to the standard layout of signals at some ends of sidings. At Shoshone, Colo., the siding was not lengthened from 80 cars on account of short tunnels at each end and the cost would have been prohibitive to "daylight" and extend the sidings. On account of the tunnels obstructing the view of the entering signals if placed standard, they were installed at the opposite end of the tunnel. The leaving signals, account of curvature and cliffs limiting their sighting distance, were also located much further than standard. The OS or detector track circuits are 800 feet in length.

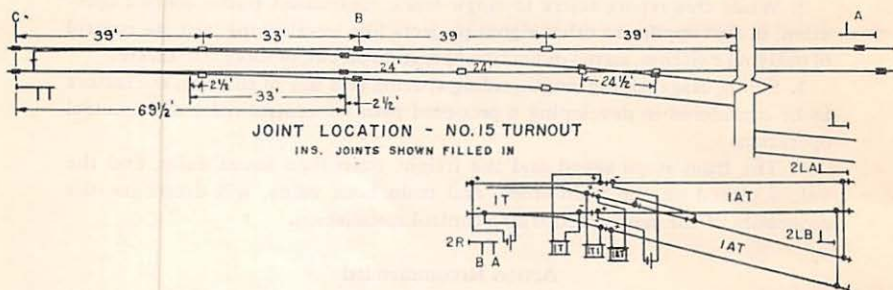
Due to the limited length of the siding, delays were experienced and practically no non-stop meets were made. By an expenditure of less than \$150, release route locking was installed for the entering movement with the result that the power switch could be reversed before the rear of the train was out of the usual OS section. This permitted the clearing of the dwarf signal immediately on the departure of the train on the main track.

This railroad has always utilized pre-conditioning in order to expedite train movement and has installed very sensitive high voltage detector circuits and provided the two track circuit release for locking circuits. Switch machine operation is normally 10 seconds with 131-pound, 33-foot switch points.

Since the main track unrestricted movement is limited to 30 miles per hour, account curvature, the result in train movement has been to hasten departure

of waiting trains 10 seconds which virtually results in the equivalent of a passing track extension of 440 feet at each end. Since the 880 feet equivalently gained, at a cost of \$6.00 per foot, cost of a siding extension (no grading) is \$5,280.00, the expenditure of approximately \$300.00 for release route locking is well justified.

Similar locations are likewise equipped. Figure 1 shows the insulated joint and track circuit arrangement at end of mentioned siding.



For Standard Layout

Speed m.p.h.	Feet per second	Dist. A.C.	Dist. B.C.	Dist. gained	Time gained
60	88.0	406'	69' 6"	336' 6"	3.82
50	73.3				4.58
45	66.0				5.09
30	44.0				7.64
15	22.0				15.3

Fig. 1.

Action Recommended

Acceptance as information.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 135-42, Manual Part 22.
Revision of Specification 151-49, Manual Part 112.
Revision of A.A.R. Sig. Sec. 1047A, 1631D and 1632D.
Revision of Requisites for Track Welding or Heat Treating in Track Circuit Territory, Manual Part 156.
Revision of Requisites for Minimizing the Effect of Foreign Current on Direct Current Track Circuits, Manual Part 127.
Revision of Specification 199-44, Manual Part 194.
Revision of Specification 160-39, Manual Part 100.
Revision of Specification 78-39, Manual Part 122.
Revision of Specification 162-43, Manual Part 50.
Revision of Specification 157-45, Manual Part 93.
3. Protection against lightning.
10. Devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand.

Cooperative report. Development of proposed inductive coordination measures involving railroad power lines and power equipment, as a result of the adoption of the principles and practices for the inductive coordination of railway electric supply facilities and the communication facilities of the Bell System.

Cooperative report. American Standards Association—Lightning Arresters—Project C62.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.

A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

N.E.M.A.—National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee IV at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

Specification 151-49—Plug Type Rail Bonds and Track Circuit Connectors—Manual Part 112.

Specification 254-49—Twist Drills for Bond Holes—Now in Manual Part 259.
Instructions for Operation of Power Machines and Drilling of Holes for Rail Bonding—Now in Manual Part 260.

Instructions for Resharpening of Twist Drills for Bonding—Now in Manual Part 261.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

- Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements—Now in Manual Part 211.
- Specification 180-49—Detachable Type Neutral Direct Current Relay for Non-Vital Circuits—Now in Manual Part 145.
- Specification 80-49—Color Light Signal, Doublet Lens Type—Now in Manual Part 146.
- Specification 81-49—Position Light Signal—Now in Manual Part 147.
- Specification 249-49—Impulse Transformer for Coded System Control—Now in Manual Part 262.
- Specification 154-49—Tractive Armature Direct Current Neutral Relay with Two Contact Fingers—Now in Manual Part 101.
- Specification 105-49—Tractive Armature Direct Current Neutral Relay with Two or More Contact Fingers—Now in Manual Part 123.
- Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data—Now in Manual Part 132.

13. *Identification.*

(a) Mechanism shall be plainly marked with Manufacturer's references.

(b) Magnet coils and resistors shall be plainly marked with Manufacturer's references.

14. *Inspection.*

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

15. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

16. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

17. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

18. *Warranty.*

(a) Manufacturer shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-6-a-1.

Mechanism shall operate the switch points to the normal or reverse position.

R-6-a-2.

Mechanism shall perform its operation in the following sequence:

- (a)
- (b)

R-6-d-12.

- (a) Hand crank shall not be furnished.
- (b) Mechanism shall be designed to permit operation by use of hand-operating and selector levers.
- (c) Mechanism shall be designed to permit operation by use of hand-operating and selector levers and hand crank.

R-6-d-13.

- (a) Motor-driven mechanism case shall be provided without crank opening for hand operation.
- (b) Latch-out feature shall not be furnished.

R-6-d-18.

Mechanism operating rod shall have maximum stroke of in.

R-6-d-23.

Point detector shall not be furnished.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 101-43—Electric Motor Switch Operating Mechanism, Manual Part 104.

ECONOMICS OF "OFF TRACK" EQUIPMENT*

Trenching machines.

One type of trenching machine consists of a "Jeep" to which the trenching equipment is mounted on the rear of the machine, which can be either the rear wheel drive or the four-wheel drive type.

The trenching equipment consists of an adjustable metal arm over which a chain equipped with digger bits is operated through a power take-off attachment. The trencher is raised or lowered by a large hand wheel. When in the raised position, it does not interfere with the roadability of the Jeep. The machine can be moved between widely separated jobs with a minimum loss of time. The trencher can be lowered and placed in operation in a matter of minutes. It can be removed from or attached to the Jeep in approximately 3 hours when it is desired to use the Jeep for transportation purposes only.

The trencher is ordinarily designed for two sizes of digger arms, one for a 36-inch depth and one for an 84-inch depth. The digger bits ordinarily furnished are for widths of 6, 8, 10 or 12 inches.

Another type consists of a small tractor, rubber-tired, with the trenching device attached on the rear of the tractor. The trencher is the bucket type with the buckets attached to an endless chain which can be raised or lowered to depth of trench desired. This type is for digging trenches of 12 inches wide and maximum of 60 inches deep.

This type of machine can also be equipped with a blade for back filling or small bulldozing jobs and can have a hole-digging device or a lifting boom attached in place of the "trencher," if desired to adapt the tractor for such work.

The digging speed of machines described varies according to nature of conditions encountered, maximum speed being 300 feet per hour.

For ordinary trenching at signal locations, the trench-digging machines are of no advantage. Their use is practically confined to jobs that require long trenches such as those at ends of sidings in centralized traffic control installations, retarder yards, or any installation where long trenches are necessary and where the Jeep can be operated.

The cost of either machine with attachments is approximately \$5,000. The average cost of hand digging is \$0.43 per foot, whereas the average cost for "trenching" by this machine is \$0.19 per foot, resulting in a saving of \$0.24 per foot.

Action Recommended

Acceptance as information.

* Previous report appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 68 and 512.

COMMITTEE II—INTERLOCKING

Personnel

H. A. Hudson, Chairman

W. G. Salmonson, Vice-Chairman

B. J. Alford	C. B. Mason
R. B. Amsden	H. A. Maynard
G. B. Blatt	H. L. Moseley
C. F. Brooks	K. L. Muse
J. J. Clancy	L. E. Scoles
L. Cone	V. P. Shepardson
C. M. Duffy	R. W. Troth
W. A. Ford	C. M. Wallace
D. W. Fuller	J. F. Yerger
C. F. Grundy	F. J. Ackerman*

J. P. Hopton*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Collaborate with A.R.E.A. Committee 5 on switch, frog and crossing layout plans, in order to make layouts as universal as possible for the application of signals and interlocking, including location of insulated rail joints in turnouts, crossovers and crossings.
4. Investigate and prepare recommendations to A.R.E.A. Committee 5 for inclusion of application of roller bearings to interlocked and spring switch layout plans, collaborating in accordance with assignment 3.

The Committee submits for consideration, reports on the following subjects**:

1. Revision of Specification 152-43, Manual Part 30.
Revision of Specification 101-43, Manual Part 104.
Revision of A.R.A. Sig. Sec. 1457B.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee II at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

Specification 147-49—Car Retarder System—Now in Manual Part 27.

Specification 245-49—Electric Car Retarder Control Machine—Now in Manual Part 251.

Specification 241-49—Electro-Pneumatic Car Retarder Control Machine—Now in Manual Part 252.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

- Specification 246-49—Electric Car Retarder—Now in Manual Part 253.
Specification 242-49—Electro-Pneumatic Car Retarder—Now in Manual Part 254.
Specification 247-49—Electric Switch Operating Mechanism for Yards—Now in Manual Part 255.
Specification 243-49—Electro-Pneumatic Switch Operating Mechanism for Yards—Now in Manual Part 256.
Specification 248-49—Electric Skate Operating Mechanism—Now in Manual Part 257.
Specification 244-49—Electro-Pneumatic Skate Operating Mechanism—Now in Manual Part 258.
Specification 76-49—Electric Interlocking Machine—Now in Manual Part 85.
Specification 128-49—Mechanical Time Release—Now in Manual Part 129.

(Revision of A.A.R. Signal Section Specification 152-43)
A.A.R. SIGNAL SECTION SPECIFICATION 152-50.

ELECTRO-PNEUMATIC SWITCH OPERATING MECHANISM

1. *Purpose.*

(a) This specification is for the purpose of providing an electro-pneumatically operated mechanism with or without dual control for operating and locking switches, derails and other movable apparatus. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Drawings.*

(a) Purchaser's drawings referred to in this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

5. *Design and functional requirements.*

(a) Power and hand throw operation.

1. Mechanism shall operate the switch points to the normal or the reverse position and lock the points in these positions.

2. Mechanism shall perform its operation in the following sequence:

(a) Unlock switch.

(b) Operate switch.

(c) Lock switch.

(d) Indicate.

3. Circuit controlling device shall be so designed that its operation will be dependent upon and follow the movement of the mechanism and that the indicating circuits will not be energized until the mechanism has completed its operation.

4. Point detector feature shall be dependent upon and follow the movement of the switch point, and shall be so designed that the connection to the switch point can be adjusted so that the circuit controller contacts will be prevented from assuming the positions indicating point closure if the switch point is closed with a $\frac{1}{4}$ in. obstruction placed between stock rail and switch point 6 in. from end of point.

5. *Design and functional requirements.*—Continued.

5. Mechanism shall be so designed that it can be stopped, reversed, or obstructed at any point of its movement without damage.

(b) Power operation only (mechanisms with or without dual control).

1. Mechanism shall be so designed that it will follow the movement of the controller at the point of control.

2. Mechanism shall be so designed that it will hold switch points in locked position in the event of failure of the air supply.

3. Circuit controlling device shall be so designed that the air pressure will be automatically restored to the cylinder in event of the switch becoming partially unlocked.

(c) Hand throw operation only (dual-control mechanisms).

1. Mechanism shall be so designed that when the hand throw lever is engaged its position will have a fixed relationship with switch position and will operate the mechanism through the same stroke as when operated by power.

2. To change from hand throw to power operation, the selector lever shall perform functions in the following sequence:

(a) Check that the hand throw lever is in one or the other extreme position and lock it in that position.

(b) Disengage the hand throw lever, close cylinder exhaust ports and open air supply ports.

(c) Close control circuits.

3. To change from power to hand throw operation, the selector lever shall perform functions in the following sequence:

(a) Open control circuits.

(b) Close air supply ports and open cylinder exhaust ports; and operate spring clutch so it can engage the hand throw lever when the lever is aligned with position of the mechanism.

(c) Unlock the hand throw lever.

(d) Air pressure.

1. Apparatus shall be designed for operation on 60 to 105 lbs. per sq. in.

2. Means shall be provided to either regulate the air supply or restrict the exhaust to control speed of operation.

(e) Mechanism.

1. Mechanism in locked position shall be capable of withstanding stress equivalent to a thrust of 20,000 lbs. either on the switch operating or locking connection.

2. Mechanism and circuit controlling devices shall be enclosed in a substantial metallic weatherproof case designed for mounting on ties. The covers of the case shall be renewable and when open shall permit access to all parts.

5. *Design and functional requirements.*—Continued.

Covers over circuit controlling devices shall be equipped with suitable fastenings for the application of Purchaser's padlock.

3. Mechanism and case shall be so designed that lock rod may be readily removed. Ends of plunger or locking dogs and holes or notches in lock rod shall have square edges. Such holes or notches shall be not more than $\frac{1}{8}$ in. wider than the plunger.

4. Mechanism case shall be provided with wire entrance of ample size, conveniently located for access to binding posts.

5. Mechanism and case shall be so designed that they will be applicable for right or left-hand operation and be interchangeable in the field.

6. Mechanism and case shall be so designed that the alignment of the lock and operating connections and the location and kind of fastening to switch ties shall conform to switch layout drawings. Operating rod shall have a maximum stroke of 6 in.

7. Mechanism shall be so designed that all unused openings shall be securely closed, and that the used openings be provided with suitable hoods to prevent snow interference.

8. Circuit controlling device and point detector shall be housed in a separate compartment of the mechanism case, which compartment shall, as far as practicable, be non-sweating and dust-proof and have a separate metallic cover.

9. Contact members shall be made of corrosion-resisting metal of sufficient mechanical strength and current-carrying capacity to satisfactorily operate in connection with the circuits used.

10. Movement of the contact members shall be such as will insure a wiping contact.

11. Pipe entrances shall be of ample size and conveniently located for external connections.

(f) *Electro-pneumatic valve.*

1. Electro-pneumatic valve shall be enclosed in a substantial metallic ventilated weatherproof case designed for mounting independent of the switch mechanism, the covering of which case shall be removable and equipped with suitable fastenings for application of Purchaser's padlock, and when open shall permit access to all parts.

2. Case shall be provided with wire entrance of ample size conveniently located for access to binding posts.

3. Circuit controlling device shall be provided to be actuated by and form an integral part of the valve and be so designed that indication circuit carried through it will insure that the valve position corresponds to position of switch and lever before indication is completed.

5. *Design and functional requirements.*—Continued.

4. The valve shall be so designed that it will shut off air supply to and will exhaust air from the cylinder through circuit action after switch mechanism has completed its stroke and indication circuit has been completed.

5. Air strainer of sufficient size and so constructed as to insure an adequate supply of air free from foreign substance that may interfere with the operation of the valves or cylinder shall be incorporated in the body of the valve and shall be easily removed for cleaning.

6. Pipe entrance shall be of ample size and conveniently located for external connections.

7. Each valve magnet shall be enclosed in a metallic shell.

8. Magnets shall be designed for operation at volts d.c. or volts, cycles a.c.

9. Magnets shall operate satisfactorily when the voltage is reduced 20 per cent below rated voltage.

(g) *Lubrication.*

1. Provision shall be made for convenient lubrication of mechanism.

2. Exposed oil holes shall be provided with weatherproof oil cups, covers or approved fittings for pressure lubrication. Fittings for pressure lubrication shall be provided where practicable.

6. *Terminal screws and binding posts.*

(a) Terminal screws and washers shall conform to Manufacturer's drawings.

(b) Material for terminal screws and washers shall be in accordance with Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.

(c) Threaded receptacles for terminal screws shall be mounted so they cannot be turned in the base or frame to which applied, properly insulated.

(d) Binding posts, nuts and washers shall conform to Drawing 1070, detail 107010.

(e) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(f) Binding posts shall be spaced not less than 1 in. centers.

7. *Finish.*

(a) Metal parts, except where parts used are inherently resistant to corrosion, shall be protected against corrosion except where such protection will interfere with the proper functioning of that part. Zinc or cadmium shall not be used on current carrying parts.

(b) Material used for protection against corrosion shall neither soften nor flake under ordinary conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

8. *Paint and painting.*

- (a) Paint and painting shall be in accordance with Specification 120, Manual Part 110.

9. *Coil insulation.*

- (a) Coils shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

- (b) D.C. coils shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

(c) A.C. coils shall be treated by impregnation or tipping with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in winding coils shall be chemically neutral.

(f) Coils shall be so insulated that they will withstand the insulation test provided in section 10.

10. *Dielectric requirements.*

- (a) Electrical apparatus assembled shall withstand for one minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

(c) Separate windings, which are insulated from each other, shall withstand for one minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency should be impressed across the windings of alternating current coils without any excessive flow of current indicating a short circuit.

11. *Identification.*

(a) Mechanism shall be plainly marked with Manufacturer's references.

(b) Magnet coils and resistors shall be plainly marked with Manufacturer's references.

12. *Inspection.*

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

13. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

14. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

15. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

16. *Warranty.*

(a) Manufacturer shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty

16. *Warranty*.—Continued.

being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 152-43—Electro-Pneumatic Switch
Operating Mechanism, Manual Part 30.

(Revision of A.A.R. Signal Section Specification 101-43)
A.A.R. SIGNAL SECTION SPECIFICATION 101-50.

ELECTRIC MOTOR SWITCH OPERATING MECHANISM

1. *Purpose.*

(a) This specification is for the purpose of providing motor-driven mechanism with or without dual control for first and second voltage ranges for operating and locking switches, derails and other movable apparatus. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Drawings.*

(a) Purchaser's drawings referred to in this specification form an essential part hereof.

(b) Contractor shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design and functional requirements.*

(a) Power and hand throw operation.

1. Mechanism shall operate the switch points to the normal or reverse position and lock the points in these positions. *R-6-a-1.

2. Mechanism shall perform its operation in the following sequence (*R-6-a-2):

- (a) Unlock switch.
- (b) Operate switch.
- (c) Lock switch.
- (d) Indicate.

(b) Power operation only (mechanisms with or without dual control).

* Alternate requisites section.

6. *Design and functional requirements.*—Continued.

1. Normal operating voltage for first range low speed mechanism shall be 20; the time of operation with this voltage at the motor terminals shall not exceed 30 seconds when operating under the load requirement shown on Drawing 1457, nor shall it exceed 40 seconds at 16 volts. This test shall be made with all parts of the mechanism adjusted as recommended by the Manufacturer for use in normal service.

2. Normal operating voltage for first range high speed mechanism shall be 20; the time of operation with this voltage at the motor terminals shall not exceed 15 seconds when operating under the load requirement shown on Drawing 1457, nor shall it exceed 22 seconds at 16 volts. This test shall be made with all parts of the mechanism adjusted as recommended by the Manufacturer for use in normal service.

3. Normal operating voltage for second range mechanism shall be 110; the time of operation with this voltage at the motor terminals shall not exceed 4.5 seconds when operating under the load requirement shown on Drawing 1457, nor shall it exceed 5 seconds at 99 volts. This test shall be made with all parts of the mechanism adjusted as recommended by the Manufacturer for use in normal service.

4. First range high speed and low speed mechanisms with 20 volts at the motor terminals, and second range mechanism with 110 volts at the motor terminals shall be capable of pulling 3,800 lbs. at end of stroke without damage. Friction clutch, if used, may be adjusted higher than normal for this test.

(c) Hand throw operation only (dual-control mechanisms).

1. To change from power to hand throw operation, the selector lever shall perform functions in the following sequence:

(a) Open control circuits.

(b) Operate spring clutch so it can engage the hand throw lever when the lever is aligned with position of the mechanism, and disengage motor mechanism after it engages the hand throw lever.

(c) Unlock the hand throw lever.

2. To change from hand throw to power operation, the selector lever shall perform functions in the following sequence:

(a) Check that the hand throw lever is in one or the other extreme position and lock it in that position.

(b) Operate spring clutch so it can engage motor operating mechanism when teeth align, and disengage hand throw lever after the clutch engages the motor mechanism.

(c) Close control circuits.

6. *Design and functional requirements.*—Continued.

(d) Mechanism.

1. Mechanism and circuit controlling devices shall be enclosed in a substantial metallic weatherproof case, designed for mounting on two tie supports, the covering of which case shall be removable and equipped with suitable fastenings for application of Purchaser's padlock, and when open shall permit access to all parts. Means for readily draining oil and water accumulations shall be provided.

2. Mechanism and case shall be so arranged that lock rod may be readily removed. Ends of plunger or locking dogs and holes or notches in lock rod shall have square edges. Such holes or notches shall be not more than $\frac{1}{8}$ in. wider than the plunger.

3. Mechanism case shall be provided with wire entrance of ample size, conveniently located for access to binding posts, equipped with adapter castings and flexible conduit, arranged to protect wires from mechanical injury.

4. Mechanism shall be so designed that it can be stopped, reversed, or obstructed at any point of its movement without damage.

5. Mechanism shall be so designed that it will follow the movement of the controller at the point of control.

6. Mechanism shall be so designed that the switch points are moved to the normal or reverse position and are locked before the indication for the respective position can take place.

7. Circuit controlling device shall be so designed that its operation will be dependent upon and follow the movement of the mechanism.

8. Point detector feature shall be dependent upon and follow the movement of the switch point, and shall be so designed that the connection to the switch point can be so adjusted that the circuit controller contacts will be prevented from assuming the positions indicating point closure if the switch point is closed with a $\frac{1}{4}$ in. obstruction placed between stock rail and switch point 6 in. from end of point.

9. Mechanism shall be so designed that it will hold switch points in locked position in the event of failure of power supply.

10. Mechanism shall be designed to prevent movement due to vibration or external force applied to the connections.

11. Mechanism in locked position shall be capable of withstanding stress equivalent to a thrust of 20,000 lbs. either on the switch operating or locking connection.

12. Mechanism shall be designed to permit operation by use of hand crank. Crank shall be furnished as an independent part of the mechanism. *R-6-d-12.

* Alternate requisites section.

6. *Design and functional requirements.*—Continued.

13. Motor-driven mechanism case shall be provided with crank opening for hand operation with a metallic weather-proof cover attached on the outside of the case, and equipped with suitable fastenings for application of Purchaser's padlock. The latch-out feature shall be such that motor operation will not obtain until it has been restored. *R-6-d-13.

14. Hand-operating and selector levers of a dual-control mechanism and their connections shall form an integral part of the switch operating mechanism.

15. Hand-operating lever of a dual-control mechanism shall be located on side of mechanism away from track. Hand-operating lever shall be marked N (normal), R (reverse), and selector lever shall be marked Power, or Motor and Hand.

16. Dual-control mechanism shall be provided with suitable keepers with latches for normal and reverse positions of levers, and the latches shall be provided with suitable fastenings for application of Purchaser's padlock.

17. Mechanism and case shall be so designed that they will be applicable for right or left-hand operation and be interchangeable in the field.

18. Mechanism and case shall be so designed that the alignment of the lock and operating connections and the location and kind of fastening to switch ties shall conform to switch layout drawings. Operating rod shall have maximum stroke of 6 in. *R-6-d-18.

19. Mechanisms shall be so designed that all unused openings shall be securely closed, and that the used openings be provided with suitable hoods to prevent snow interference.

20. Circuit controlling device and point detector shall be housed in a separate compartment of the mechanism case, which compartment shall, so far as possible, be non-sweating and dust-proof and have a separate metallic cover.

21. Contact members shall be made of corrosion-resisting metal of sufficient mechanical strength and current-carrying capacity to satisfactorily operate in connection with the circuits used.

22. Movement of the contact members shall be such as will insure a wiping contact.

23. Point detector shall be provided with contacts required to control switch indicating relay. *R-6-d-23.

(e) Motor.

1. Motor shall be enclosed in a substantial metallic weatherproof case, the cover of which shall be equipped with suitable fastenings for application of Purchaser's padlock,

* Alternate requisites section.

6. *Design and functional requirements.*—Continued.

and when open shall permit access to terminals, commutator and brushes, or their equivalent.

2. Motor shall be attached to, and form a part of, the mechanism and shall be removable therefrom.

3. Case shall be provided with wire entrance of ample size, conveniently located for access to binding posts, and arranged to protect wires from mechanical injury.

4. Motor shall be designed for:

(a) voltage range d.c.

(b) voltage range
cycles a.c.

(f) Bearings.

1. Bearings shall be of ample dimensions to insure reasonable durability.

2. Provision shall be made for proper and convenient lubrication of mechanism.

3. Motor shall be designed to prevent oil from bearings getting on brushes, commutator or windings.

4. Exposed oil holes shall be provided with weatherproof oil cups or covers.

7. *Wiring.*

(a) Internal wiring shall be neatly arranged and placed in ducts or channels of ample capacity forming an integral part of the apparatus.

(b) Wire for internal wiring shall be insulated and of strands of tinned or leaded copper not larger than No. 27 A.W.G. wire. The aggregate cross-section of the strands shall be not less than No. 14 A.W.G. wire. Wire eyelet shall be provided at each end and soldered in, or other suitable terminal provided.

(c) Wiring diagram shall be securely attached in the mechanism case.

8. *Binding posts.*

(a) Binding posts, nuts and washers shall conform to Drawing 1070, detail 107010.

(b) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(c) Binding posts shall be spaced not less than 1 in. centers.

(d) Binding posts for external wires shall, as far as practicable, be located adjacent to wire inlet, and duct spaces provided.

9. *Finish.*

(a) Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of that part. Zinc or cadmium shall not be used on current-carrying parts.

(b) Material used for protection against corrosion shall neither soften nor flake under ordinary conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

10. *Paint and painting.*

(a) Paint and painting shall be in accordance with Specification 120, Manual Part 110.

11. *Coil insulation.*

(a) Coils shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

(b) Coils external to the housing of moving parts shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

(c) Coils adjacent to moving parts, armature air gaps or contacts shall be treated by impregnation or dipping with insulating varnish in accordance with Requisites for Varnish for Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in winding coils shall be chemically neutral.

(f) Coils shall be so insulated that they will withstand the insulation test provided in section 12. This test shall be made by mounting coil on a snugly fit metal mandrel and making breakdown tests between mandrel and winding; also by standing coil on each end in turn on a metal plate and testing between plate and winding.

12. *Dielectric requirements.*

(a) Electrical apparatus assembled shall withstand for one minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

(c) Separate windings, which are insulated from each other, shall withstand for one minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit.

A.A.R. SIG. SEC. 1457C.

**LOAD REQUIREMENT FOR POWER-OPERATED
SWITCH MECHANISM**

In connection with the revision of Specification 101-43, Manual Part 104, it was apparent that some type of performance check was desirable. Such a check no doubt was intended to be provided by A.A.R. Sig. Sec. 1457B—Operating and Overload Curve Chart; however, it does not clearly indicate the type of test required nor permit the setting up of practical test apparatus.

The load requirement curve on A.A.R. Sig. Sec. 1457C simulates actual field conditions for switch operation. The values shown take into account the data previously obtained and reported by Committee II on "Use of Roller Bearings on Interlocked and Spring Switches" at the 1947 Annual Meeting (A.A.R. Signal Section 1946 Proceedings, Vol. XLIV, pp. 66-A and 357-A).

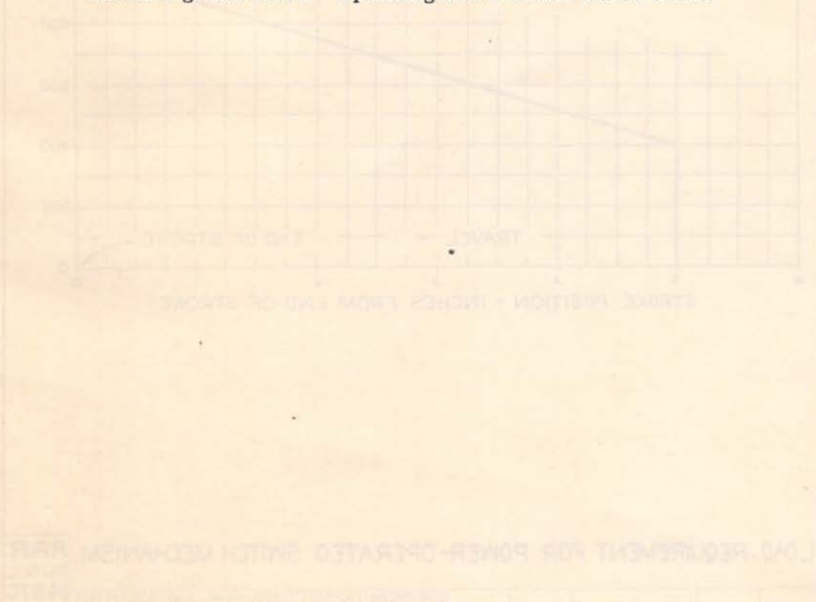
The load requirement curve shown on A.A.R. Sig. Sec. 1457C is basic for any power-operated switch mechanism and is applicable for use in specifications for such mechanisms. Use of this reference is made in Specification 101-50.

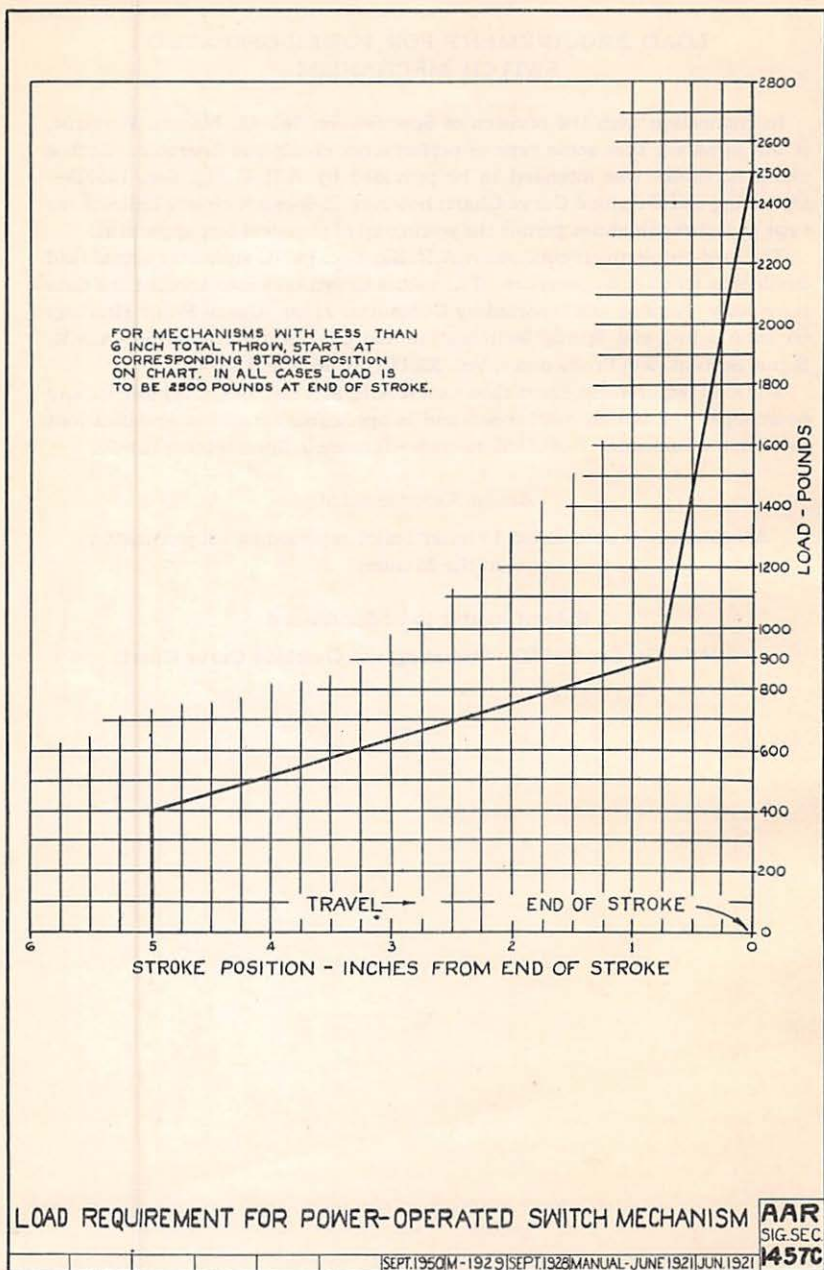
Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

A.A.R. Sig. Sec. 1457B—Operating and Overload Curve Chart.





Electric motor operating mechanism shall be in accordance with Specification 101, Manual Part 104.

COMMITTEE III—SIGNAL SHOP PRACTICE

Personnel

E. S. Taylor, Chairman

..... Vice-Chairman

P. P. Ash

R. E. Testerman

E. R. Franchiseur

W. M. Vogts

J. E. Hillig

A. M. Weeks

J. G. Karlet

J. F. Yerger

J. P. Stevely

S. M. Day*

H. V. Stone

A. W. Fisher*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Recommend facilities and procedure for test and repair of relays.
2. Requisites for containers for shipping relays between shop and field.
3. Investigate and report on the factors involved in the establishment of repair facilities.
4. Investigate and report on the policy to be established and followed in the salvaging or repairing of materials or devices.

The Committee submits for consideration, reports on the following subjects**:

2. Requisites for Containers for Shipping Relays and Similar Apparatus.
3. Formula for determining cost of repairing signal material.
4. Requisites for Salvaging or Repairing of Signal Material.

FORMULA FOR DETERMINING COST OF
REPAIRING SIGNAL MATERIAL

Under assignment 3—Investigate and report on the factors involved in the establishment of repair facilities, the Committee believes that a careful and uniform accounting of all shop costs should be the first and most important step for justifying repair facilities and, therefore, submits "Formula for Determining Cost of Repairing Signal Material," which is an outline for guidance for the use of signal shops whenever occasion arises for determining the cost of repairing specific signal devices or other items.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

This outline develops formula that recognizes all the factors that appear to be necessary for arriving at true costs and is in practical accord with standard accounting practice.

The use of this outline is recommended as a basis for fundamental guide to signal department supervision of shop facilities. It may not in all cases agree in detail with the accounting currently in effect on a given railroad, but can be used as suggested, either for periodic check or for continuous use.

The formula is as follows:

Direct charges to store orders.

- | | | |
|---|-------|-----|
| 1. Direct labor..... | ..... |  |
| Plus following, when applicable: | | |
| (a) Railroad retirement (6%)..... | ..... |  |
| (b) Unemployment insurance (0.5%)..... | ..... |  |
| (c) Vacation allowance (3%)..... | ..... |  |
| (d) Miscellaneous local compensation insurance and
taxes (.....%)..... | | |
| Total..... | ..... | (A) |
| <hr/> | | |
| 2. Direct material..... | ..... |  |
| (a) Current stores expense (when applicable) (.....%)..... | ..... |  |
| Total..... | ..... | (B) |
| <hr/> | | |
| Total direct charges (A plus B)..... | ..... | (C) |

Shop overhead.

- | | | |
|---|-------|-----|
| 1. Labor: | | |
| (a) Supervision..... | ..... |  |
| (b) Clerical force..... | ..... |  |
| (c) Truck drivers' wages (unless chargeable to store
order)..... | | |
| (d) Janitor service, etc..... | ..... |  |
| (e) Engineering..... | ..... |  |
| Total..... | ..... |  |
| Plus following, if applicable: | | |
| (f) Railroad retirement (6%)..... | ..... |  |
| (g) Unemployment insurance (0.5%)..... | ..... |  |
| (h) Vacation allowance (3%)..... | ..... |  |
| (j) Miscellaneous local compensation insurance and
taxes (.....%)..... | | |
| Total overhead labor..... | ..... | (D) |
| <hr/> | | |

Shop overhead.—Continued.

2. Supplies, etc.:

Stationery and office supplies, etc.....	.....
Telephone, water, heat, light and gas, etc.....	.....
Rental of building or space occupied.....	.....
Non-durable tools such as files, hack saw blades, sand and emery paper, etc.....	.....
Paint, oil, grease, chemicals, soap, towels, toilet paper, etc.....	.....
Personal expenses of shop personnel.....	.....
Small tools under \$500 value.....	.....
Depreciation on tools, instruments and machines.....	.....
Lost or broken material and tools, etc.....	.....
Cost of truck operation.....	.....
Total cost of supplies, etc.....	 (E)
Total cost of overhead (D plus E).....	 (F)

3. Overhead percentage for month $\frac{F}{A}$ times 100 equals.....% (G)

Total cost of each shop order equals (A times G) plus C..... (H)

Total cost for one item on a shop order equals total cost
(H) divided by the total number of items.

Action Recommended

Acceptance as information.

A.A.R. SIGNAL SECTION REQUISITES.

SALVAGING OR REPAIRING OF SIGNAL MATERIAL

1950

1. All signal material available for repairs generally falls into two classifications:

(a) Material which should not be repaired:

1. Obsolete material not approved for reuse.

2. Material which experience has shown cannot be economically repaired.

3. Material which is so badly damaged that repairs are not justified.

(b) Material where cost of repairs and life expectancy compared with cost and life expectancy of new material indicate that repairs might be justified. The justification should be determined as follows:

1. Policy to be followed for repairs to a device should be governed by the average cost of such repairs over a given period.

2. A fixed percentage of the cost of new material should be established, based on past experience as a limit beyond which repairs are not justified. Generally this percentage will range from 50 to 80 per cent of the new cost of like material.

(a) If inspection indicates a cost less than the established percentage, then repairs are justified.

(b) If inspection indicates a cost equal to or greater than the established percentage, material should not be repaired, unless special consideration justifies.

3. Life expectancy of repaired material should be compared with life expectancy of new material. Under normal circumstances certain materials or devices should not be repaired even when the new value is within the approved limit as illustrated in the following example:

Example:

The cost of a piece of new material might be \$50 with a life expectancy of 5 years, while the cost of repairing a like piece of used material would be \$30 with a life expectancy of $2\frac{1}{2}$ years. The labor cost of field replacement might be \$3. In this instance, the cost of the new material in place over a 5-year period would be \$53 while the cost of the repaired material in place would be \$66.

2. Repair work should include replacement of obsolete detail parts and inclusion of revised or new details that are available for improved performance.

3. All apparatus which is repaired shall be assembled, adjusted and tested in accordance with A.A.R. Signal Section instructions, or Manufacturer's specifications.

Action Recommended

Acceptance for submission to letter ballot.

A.A.R. SIGNAL SECTION REQUISITES.

CONTAINERS FOR SHIPPING RELAYS AND
SIMILAR APPARATUS

1950

1. *Purpose.*

(a) The purpose of these requisites is to provide containers for railroad use for shipping relays and similar apparatus.

2. *General requirements.*

- (a) Containers should be light in weight.
- (b) Containers shall be strong, durable, and with means provided internally to absorb shocks.
- (c) Containers shall be designed to prevent apparatus from shifting in the container.
- (d) Packing such as waste, excelsior, paper, etc., shall not be used.
- (e) Containers shall be constructed of water repellent material or treated so as to be made water repellent.
- (f) Containers should be arranged to exclude moisture and dirt.
- (g) Means shall be provided for locking containers with railroad padlock.
- (h) Means shall be provided for holding covers for containers firmly in place, preferably without hinges.
- (i) Suitable handle or handles shall be provided.
- (j) Hasp or fasteners for cover shall be arranged to prevent accidental opening.
- (k) Containers shall be marked "Fragile" and "Handle with Care."
- (l) Provision shall be made on containers for application of shipping tag and railroad serial number.

Action Recommended

Acceptance for submission to letter ballot.

COMMITTEE IV—AUTOMATIC BLOCK SIGNALING

Personnel

E. N. Fox, Chairman

L. B. Yarbrough, Vice-Chairman

H. D. Abernethy	W. T. Lewis
C. M. Acker	P. H. Linderoth
R. B. Amsden	H. A. Maynard
J. A. Beoddy	C. F. Nelson
L. S. Bottinelli	S. E. Noble
F. L. Chatten	M. A. Otterbourg
W. L. Dayton	D. H. Steiner
J. R. Heisler	H. G. Stiebeling
H. Jensen	R. E. Taylor
A. L. Jordan	W. G. Trost
T. H. Kearton	W. L. Waleen

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on protection against lightning.
4. Investigate and report on methods of improving shunting of track circuits.
5. Investigate and report on means of minimizing effects of stray grounded current and inductive interference from high tension power lines on signal track circuits.
6. Investigate and report on the use of automatic block systems, with superimposed control.
7. Investigate and report on the use of track instruments instead of track circuits for the release of electric switch locks and electric locking.
8. Investigate and report on the use of high voltage lightning arresters—various voltage ranges.
9. Investigate and report on the practicability of in-service tests of all types of lightning arresters.
10. Investigate and report on devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand, collaborating with Mechanical Division, A.A.R.
11. Investigate and report on the various types of power for operating signaling systems and the operating cost therefor.
12. Performance specification for solderless type connectors for use in wiring signal apparatus (various size conductors).
13. Investigate and report on the advisability of preparing a specification or requisites covering screw locks and signal padlocks for outside use.

(Revision of A.A.R. Signal Section Specification 135-42)
A.A.R. SIGNAL SECTION SPECIFICATION 135-50.

TRACK CIRCUIT BONDING

1. *Purpose.*

(a) This specification is for the purpose of providing bonding of railway signaling track circuits where rails do not carry return propulsion current. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Drawings.*

(a) Drawings 1047, 1048, 1086, 1556, 1631 and 1632 form an essential part hereof, as required.

(b) Contractor shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for material and workmanship meeting the requirements of this specification in its entirety.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *General.*

(a) Rail joints shall be bonded with bonds as specified by Purchaser.

(b) Switch point heel joints shall be bonded with bonds as specified by Purchaser.

(c) Rail joints in tunnels shall be bonded with bonds as specified by Purchaser.

(d) Rail joints in road crossings or platforms where planking or paving is maintained, or where bonding is inaccessible, shall be double bonded.

(e) Cross connections at crossovers and turnouts for fouling protection shall have conductivity not less than that of two No. 9 A.W.G. copper wires and shall be in accordance with Form 7004, Manual Part 206. The cross connections shall be so installed as to avoid breaks and their total resistance shall not exceed 0.006 ohm.

6. *General.*—Continued.

(f) Bonds shall be treated with corrosion-resisting material as specified by Purchaser.

(g) Frogs shall be bonded with bonds as specified by Purchaser and, as far as practicable, be so bonded that the continuity of the track circuit will be broken when they are removed from the track. Manganese frogs shall be bonded in accordance with Drawing 1556. *R-6-g.

7. *Drilling.*

(a) Twist drills for bond holes shall be in accordance with Specification 254, Manual Part 259.

(b) Drilling shall be in accordance with Instructions for Operation of Power Machines and Drilling of Holes for Rail Bonding, Manual Part 260.

8. *Bonding.*

(a) Web of rail type.

1. Drilled holes shall be $\frac{3}{8}$ in., not to exceed 0.385 in. diameter, and in same direction plug is to be driven.

2. Bonding should be done the same day holes are drilled.

3. Plugs shall be driven with a hammer approximately 3 lbs. in weight and when in place shall be tight to provide best possible contact throughout web of rail.

4. Plug type bonds shall be in accordance with Specification 151, Manual Part 112.

(b) Head of rail type, welded.

1. Bonds shall be applied to the head of rail only and shall be in accordance with Specification 178, Manual Part 141.

2. Bond terminals shall be located as low as possible on rail heads, leaving only sufficient space for removal of angle bars.

3. Bonds shall be applied within 5 in. from end of rail.

4. Bonds shall be so applied that opening of the rail ends of 1 in. will cause failure of the bond.

5. Welding rod for applying weld type bonds shall be of proper low resistance material for the bond used.

(c) Head of rail type, mechanically applied.

1. Bonds shall be in accordance with Specification 179, Manual Part 142.

2. Bonds shall be installed in accordance with Instructions for Mechanically Applied Rail Head Type Bonds and Track Circuit Connectors, Manual Part 219.

* Alternate requisites section.

9. Purchaser's order requirements.

(a) Purchaser's order shall specify the following requirements which shall be met:

1. Type of bond for rail joints.
2. Type of bond for switch point heel joints.
3. Type of special bond for rail joints in tunnels, road crossings, etc., if required.
4. Type of bond for frogs.
5. Type of corrosion-resisting material for bonds, if required.

10. Inspection.

(a) Purchaser may inspect the work at all stages of installation to determine that the requirements of this specification are being met.

11. Tests.

(a) Contractor shall make such tests as may be necessary to demonstrate to the satisfaction of the Purchaser that the bonding is in accordance with the requirements of this specification. Contractor shall provide such instruments and apparatus as may be necessary for making the tests. The instruments and apparatus shall remain the property of the Contractor.

Alternate requisites.

R-6-g.

Frogs shall be bonded in accordance with Purchaser's Drawing, dated

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 135-42—Track Circuit Rail Bonding,
Manual Part 22.

(Revision of A.A.R. Signal Section Specification 151-49)
A.A.R. SIGNAL SECTION SPECIFICATION 151-50.

PLUG TYPE RAIL BONDS AND TRACK CIRCUIT CONNECTORS

1. *Purpose.*

(a) This specification is for the purpose of providing plug type rail bonds and track circuit connectors for track circuits where rails do not carry return propulsion current. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Drawings.*

(a) Drawings 1631 and 1632 form an essential part hereof.

3. *Tender.*

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Design.*

(a) General construction and dimensions of bonds and connectors shall conform to Drawings 1631 and 1632.

7. *Conductors.*

(a) Conductor of a single-conductor bond or connector shall be stranded with such a lay that the axial length of each turn of wire will be as shown on Drawing 1631, and shall consist of one of the following (manufacturing tolerances allowed on wire sizes):

1. One copper wire surrounded by 6 galvanized steel wires, each wire 0.109 in. diameter.

2. Three copper and 16 galvanized steel wires, each wire 0.0661 in. diameter.

3. Seven copper-covered steel wires, 40 per cent conductivity, each wire 0.102 in. diameter. *R-7-a-3.

(b) Each conductor of a duplex-conductor bond or connector shall be stranded with such a lay that the axial length of each turn of wire will be as shown on Drawing 1632, and shall consist of one of the following (manufacturing tolerances allowed on wire sizes):

1. One copper wire surrounded by 6 galvanized steel wires, each wire 0.077 in. diameter.

* Alternate requisites section.

7. *Conductors.*—Continued.

2. Seven copper-covered steel wires, 40 per cent conductivity, each wire 0.081 in. diameter.

(c) Copper wire shall meet the requirements of A.S.T.M. current Specification B 3.

(d) Hard-drawn copper-covered steel wires shall meet the requirements of A.S.T.M. current Specification B 227.

(e) Steel and annealed copper-covered steel wires shall meet the following requirements as to mechanical and electrical properties:

Diameter in mils (commercial tolerance allowed)	Galvanized steel wire			Annealed copper-covered steel wire	
	109	77	66.1	102	81
Minimum strength, lbs.	476	240	215	450	280
Minimum elongation per cent in 10 in. of each wire in any conductor	8	8	8	15	15
Minimum weight in lbs. per mile-ohm at 68 deg. F.	6,000	6,000	6,000	2,220	2,220

8. *Plugs and attachment.*

(a) Plugs shall withstand being driven the entire length of the pin into a hole $\frac{3}{8}$ inch in diameter, drilled in a steel plate $\frac{1}{16}$ in. thick, without showing a crack or flaw of any kind. In addition, the plug, after being driven into the steel plate approximately one-half its length, shall withstand bending at 45 deg. without cracking or showing a fracture of any kind.

(b) Plugs shall be attached to the conductor by butt-welding, through welding or by compression of the plug head on the conductor.

(c) Welding shall be done with electric or gas devices capable of producing uniformly good results. Weld shall be so made that the ends of all the wires are united with the plug to insure a dense and homogeneous metal, which shall be free from blow holes after fusion.

(d) Plugs shall be compressed on the conductor by a suitable hydraulic or mechanical press so as to provide a good mechanical and electrical connection between the conductor and the plug.

(e) Manufacturer must subject each welded rail bond and connector of annealed strand to a stretching process sufficient to elongate bond or connector (regardless of length) to permanent set of $\frac{1}{4}$ in. to determine the quality of the welds. Bonds and connectors shall be held by their plugs in such a manner that the welds are subjected to the full strain developed in the stretching operation. Stretching machine shall be of such design that the strain will be applied to each plug and connector for not more than 1 second.

8. *Plugs and attachment.*—Continued.

(f) For compression type plugs, the Manufacturer shall adjust and maintain press so as to provide uniform compression during production. Production tests during manufacture shall be made to assure compression sufficient to provide the required joint strength.

9. *Tinning and galvanizing.*

(a) Tinning and galvanizing shall be even in thickness throughout, smooth and free from lumps.

(b) Plugs other than those of non-corrosive material shall be tinned or galvanized.

(c) After welding of annealed conductors, the junction of plug and exposed conductor shall be tinned or galvanized.

(d) After welding of hard-drawn conductors, the junction of plug and exposed conductor shall be tinned.

(e) After compressing any exposed ends of copper or copper-covered steel, conductors shall be tinned.

(f) Stub end of track circuit connectors shall be tinned 2 in.

(g) Tinning material shall be commercially pure tin or lead tin alloy, not less than 70 per cent tin. Galvanizing shall be commercially pure zinc. They shall be applied by the hot dip process.

10. *Identification.*

(a) Each plug shall be so marked that the Manufacturer of the bond or connector can be readily identified.

11. *Resistance of installed bonds.*

(a) When installed in $\frac{3}{8}$ in. drilled holes in plates of steel comparable to rail 2 in. wide and $\frac{9}{16}$ in. thick, electrical resistance shall be in accordance with Form 7058.

(b) Tests shall be made by the ammeter-milli-voltmeter or Kelvin bridge method with current taps at edge of plates outside of span of bond, on line through plug centers. Potential contacts shall be made on clean steel at points outside and 1 in. from center and on line passing through centers of drilled holes. Plates shall be effectively insulated. Tests shall be made at or corrected to a temperature of 68 deg. F. Direct current shall be used at a value not in excess of 10 amperes.

12. *Purchaser's order requirements.*

(a) Purchaser's order shall specify the following requirements which shall be met:

1. Type of conductor.
2. Type of plug and method of attachment.
3. Bond or connector and length.
4. Annealed or hard-drawn.

13. Inspection.

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

14. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

(e) Two bonds or less, from each of five packages, taken at random from each 3,000 or less bonds, and 10 or less short samples of connectors of same production, shall be selected by the Purchaser as samples for examination as to detail finish, smoothness and uniformity of tinning or galvanizing, conformity to dimension requirements of Drawing 1631 or 1632, and for test.

(f) Plugs of all sample bonds and connectors shall be calibrated, and if more than 5 per cent fail to meet the dimension requirements of Drawings 1631 and 1632, the shipment shall be rejected.

(g) One-half of the samples chosen shall be used for mechanical tests.

1. Conductors from 2 samples per 3,000 shall be tested to the applicable requirements of sections 7-c, 7-d or 7-e. If any sample fails to meet these requirements, the lot shall be rejected.

2. One sample for each 3,000 or less shall be tested to establish the quality of the joint between the conductor and the plugs.

(a) For welded bonds the plugs shall be gripped in a tensile machine and a uniform stress applied along the axis of the bond. If fracture occurs at the weld, two additional samples shall be similarly tested, and if either of these fail in the weld, the lot shall be rejected.

14. *Tests.*—Continued.

The weld shall be considered satisfactory, if a piece of each wire or plug metal adheres to each wire or plug.

(b) For compression type bonds, the plugs shall be gripped in a tensile machine and a uniform stress applied along the axis of the bond. When subjected to a tensile pull the joint between the plug and conductor shall withstand a pull of not less than 1,000 lbs.

3. Plugs from the samples used for mechanical tests shall be tested for driving and bending requirements of section 8-a. If one of these plugs fails in either of these tests, two additional samples shall be similarly tested. If more than one original sample or either of the additional samples fail, the lot shall be rejected.

(h) One-half of the samples chosen shall be used for the following tinning or galvanizing tests:

1. Galvanizing shall be tested in accordance with Specifications for Metallic Coating of Metals, Manual Part 63.

2. Tinning.

(a) Solutions.

1. Potassium ferricyanide solution: 5 grams of the salt are dissolved in 1,000 c.c. of distilled water.*

2. Hydrochloric acid solution shall have a specific gravity of 1.10, made by diluting hydrochloric acid, having a specific gravity of 1.20, with distilled water.

(b) Method.

1. Samples selected for this test shall be thoroughly cleaned with gasoline or varnish remover and then with soap and water. After rinsing the clean samples thoroughly with clear water, they shall be immersed in a hydrochloric acid solution for 1 minute, and, without wiping, dipped into a ferricyanide solution; if a blue precipitate or discoloration takes place, it indicates the tin coating has been dissolved. The samples shall then be washed with clear water to free them from the ferricyanide solution and the above operation repeated. Samples which have been plated in a satisfactory manner shall stand four immersions of 1 minute each in the hydrochloric acid solution without showing a blue precipitate or discoloration in the ferricyanide solution. If blue precipitate appears in the first test, an additional sample shall be tested. If both samples fail, the lot shall be rejected.

* Instead of distilled water, hydrant water may be used if on adding the ferricyanide it does not give a precipitate or discoloration.

14. *Tests.*—Continued.

2. Not more than five samples, 4 cycles each, shall be tested per 1,000 c.c. of hydrochloric acid solution.

15. *Packing.*

(a) Bonds and connectors 5 ft. or less in length shall be securely tied in packages of 50, with the plugs completely and carefully wrapped with burlap or equivalent protection.

(b) Bonds and connectors exceeding 5 ft. in length shall be coiled and tied singly, and packages of 25 wrapped in burlap or equivalent protection.

16. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

17. *Warranty.*

(a) Manufacturer shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any material which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-7-a-3.

Seven copper-covered steel wires, 40 per cent conductivity, each wire 0.081 in. diameter.

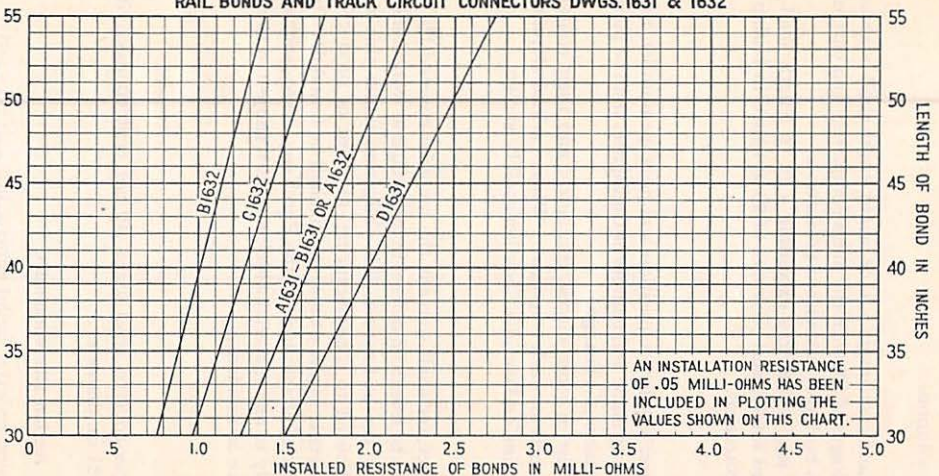
Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 151-49—Plug Type Rail Bonds and Track Circuit Connectors, Manual Part 112.

RESISTANCES OF SINGLE AND DUPLEX CONDUCTOR PLUG TYPE
RAIL BONDS AND TRACK CIRCUIT CONNECTORS DWGS. 1631 & 1632



AVERAGE RESISTANCE PER INCH OF CONDUCTOR FOR TRACK CIRCUIT
CONNECTORS AND FOR LONGER OR SHORTER BONDS THAN SHOWN ABOVE

SINGLE BONDS			DUPLEX BONDS		
CONDUCTOR TYPE	MILLI-OHMS RESISTANCE		CONDUCTOR TYPE	MILLI-OHMS RESISTANCE	
A1631 OR B1631	.0398		A1632	.0398	
C1631	.0123		B1632	.0244	
D1631	.0398				

TEMPERATURE 68° F.

AAR
SIG. SEC.
7058

RESISTANCES OF SINGLE AND DUPLEX CONDUCTOR PLUG TYPE
RAIL BONDS AND TRACK CIRCUIT CONNECTORS, DWGS. 1631 & 1632

APR 1938 M-1638 OCT 1942 M-1942 SEP 1950

A.A.R. SIG. SEC. 1047B.

WELDED TYPE RAIL HEAD BONDS AND TRACK CIRCUIT CONNECTORS

This drawing has been changed to eliminate some conductors in little demand and to indicate the application of the bond to rail head at either the 30 or 60 degree angle.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

A.A.R. Sig. Sec. 1047A—Welded Type Rail Head Bonds and Track Circuit Connectors.

A.A.R. SIG. SEC. 1631E.

SINGLE CONDUCTOR PLUG TYPE RAIL BONDS AND TRACK CIRCUIT CONNECTORS

A.A.R. SIG. SEC. 1632E.

DUPLEX CONDUCTOR PLUG TYPE RAIL BONDS AND TRACK CIRCUIT CONNECTORS

These two drawings have been changed to eliminate some conductor types in little demand, revise the ordering requirements and to agree with Specification 151-50, Manual Part 112.

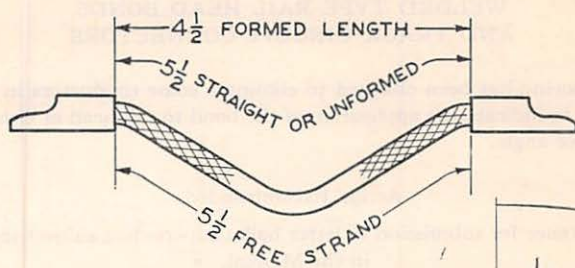
Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

A.A.R. Sig. Sec. 1631D—Single Conductor Plug Type Rail Bonds and Track Circuit Connectors.

A.A.R. Sig. Sec. 1632D—Duplex Conductor Plug Type Rail Bonds and Track Circuit Connectors.



RAIL BOND AS SHOWN.
TRACK CIRCUIT CONNECTOR,
ONE TERMINAL ONLY, UNFORMED,
LENGTH AS SPECIFIED ON ORDER,
STUB END TINNED 2 INCHES.

ORDER NUMBER		CONDUCTOR-NOMINAL DIAMETER $\frac{5}{16}$, ROPE LAY CONSTRUCTION, CENTER STRAND OF 19 WIRES, SURROUNDED BY 6 STRANDS OF 19 WIRES EACH.
BOND	CONNECTOR	
10477	10478	EACH WIRE OF CENTER STRAND ANNEALED COPPER, CENTER WIRE AND 6 SURROUNDING WIRES 0.0242 DIAMETER, 12 OUTSIDE WIRES 0.0235 DIAMETER. EACH WIRE OF OUTSIDE STRANDS GALVANIZED STEEL, CENTER WIRE AND 6 SURROUNDING WIRES 0.021 DIAMETER, 12 OUTSIDE WIRES CONSIST OF 6 WIRES 0.016 DIAMETER AND 6 WIRES 0.023 DIAMETER.
10479	104710	EACH WIRE HARD DRAWN BRONZE, 0.02 DIAMETER.

NOTES: MANUFACTURING TOLERANCES ALLOWED ON WIRE SIZES.
ALL DIMENSIONS GIVEN IN INCHES UNLESS OTHERWISE INDICATED.

WELDED TYPE RAIL HEAD BONDS
AND TRACK CIRCUIT CONNECTORS

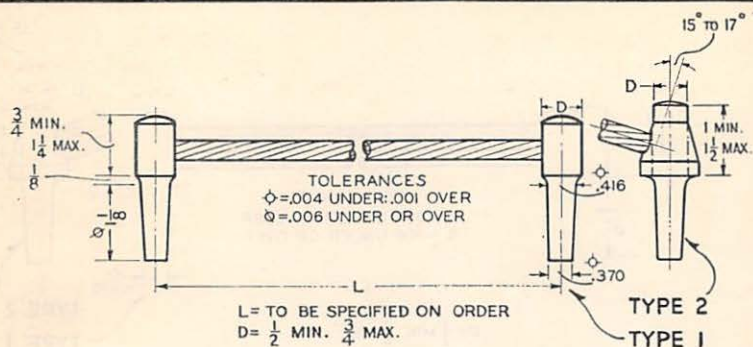
AAR
SIG. SEC.
1047B

SEP 1950 | M-1938 | APR 1938

Material shall be in accordance with Specification 178, Manual Part 141.

Sept. 1950]

Com. IV—Automatic Block Signaling



RAIL BOND AS SHOWN.
 TRACK CIRCUIT CONNECTOR,
 ONE PLUG ONLY, *
 STUB END TINNED 2 INCHES.

CONDUCTOR TYPE	WIRES IN STRAND	DIAMETER		LENGTH OF STRAND LAY
		EACH WIRE	EACH STRAND	
A1631	1 COPPER, 6 GALVANIZED STEEL	.109	.327	3.75
B1631	3 COPPER, 16 GALVANIZED STEEL	.0661	.330	2.54
C1631	7-40% COPPER COVERED STEEL	.102	.306	3.00
D1631	7-40% COPPER COVERED STEEL	.081	.243	2.75

TO BE SPECIFIED ON ORDER:

- 1 - TYPE OF CONDUCTOR.
- 2 - TYPE OF PLUG AND METHOD OF ATTACHMENT.
- 3 - BOND OR CONNECTOR AND LENGTH
- 4 - ANNEALED OR HARD-DRAWN.

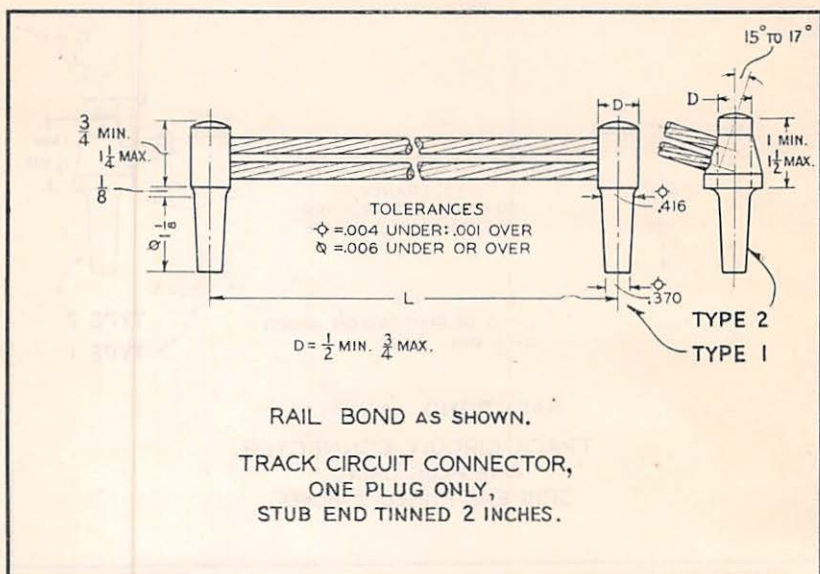
NOTES: MANUFACTURING TOLERANCES ALLOWED ON WIRE AND STRAND SIZES.
 ALL DIMENSIONS GIVEN IN INCHES UNLESS OTHERWISE INDICATED.

SINGLE CONDUCTOR PLUG TYPE RAIL BONDS
 AND TRACK CIRCUIT CONNECTORS

AAR
 SIG. SEC.
 1631 E

SEP. 1950 | M-1942 | OCT. 1942 | M-1938 | APR. 1938 | M-1933 | MAY 1933 | M-1931 | MAY 1931 | SEPT. 1930

Material shall be in accordance with Specification 151, Manual Part 112.



CONDUCTOR TYPE	WIRES IN EACH STRAND	DIAMETER		LENGTH OF STRAND LAY
		EACH WIRE	EACH STRAND	
A1632	1 COPPER, 6 GALVANIZED STEEL	.077	.231	2.54
B1632	7-40% COPPER COVERED STEEL	.081	.243	2.75

TO BE SPECIFIED ON ORDER :

- 1 - TYPE OF CONDUCTOR.
- 2 - TYPE OF PLUG AND METHOD OF ATTACHMENT.
- 3 - BOND OR CONNECTOR AND LENGTH.
- 4 - ANNEALED OR HARD-DRAWN.

NOTES: MANUFACTURING TOLERANCES ALLOWED ON WIRE AND STRAND SIZES.
ALL DIMENSIONS GIVEN IN INCHES UNLESS OTHERWISE INDICATED.

DUPLEX CONDUCTOR PLUG TYPE RAIL BONDS
AND TRACK CIRCUIT CONNECTORS

AAR
SIG. SEC.
1632 E

SEP. 1950 | M-1942 | OCT. 1942 | M-1938 | APR. 1938 | M-1933 | MAY 1933 | M-1931 | MAY 1931 | SEPT. 1930

Material shall be in accordance with Specification 151, Manual Part 112.

(Revision of Requisites for Track Welding or Heat Treating
in Track Circuit Territory)

A.A.R. SIGNAL SECTION REQUISITES.

TRACK WELDING OR HEAT TREATING IN
TRACK CIRCUIT TERRITORY

1950

Electric arc welding.

1. Connection for the ground cable shall be applied to the same individual rail or frog on which the welding is being done and as close as possible to the point being welded.
2. Ground cable clamp shall provide good mechanical and electrical contact of ample carrying capacity to handle welding current without undue heating.
3. Both cables (electrode and ground) shall be completely insulated throughout their entire length.
4. Whenever the electrode holder is not in use, it shall not contact any rail, frog, or metallic part connected thereto.
5. No resistance or current limiting device shall be inserted in the ground circuit.
6. At insulated joints, great care shall be taken not to establish an electrical connection between the two rails and an arc shall not be struck on either rail without first attaching the ground clamps to the rail on which the arc is to be struck.
7. Multiple operator welding systems, wherein two or more welding circuits are connected electrically to the same source of supply, shall not be used in track circuit territory.
8. No electric arc welding shall be performed while a train is in the block.

All Types of Welding or Heat Treating

Care of insulated joints.

9. Welding or heat treating operations shall not be carried on at more than one insulated joint affecting any one track circuit at one time.
10. When heat treating, wet asbestos pulp shall be applied over top of fibre end post. After heating the pulp shall be removed. Fibre, if damaged, shall be replaced.
11. If rail head is to be restored to shape by reforming, after providing proper protection for train operation, the insulated joint shall be removed and splice bars applied to prevent deformation of the rail head before starting the welding operation. Worn or damaged fibre shall be replaced and the insulated joint reinstalled immediately after rails have cooled sufficiently.
12. If reforming is not a part of the welding operation, the insulated joint shall be dismantled immediately after rails have cooled and worn or damaged fibre replaced and the joint reinstalled.

Care of rail head type bonds.

13. Wet asbestos pulp shall be applied in advance of the heating operation in sufficient quantity to cover entire bond.

Care of rail head type bonds.—Continued.

14. If heating operation does not increase the temperature of the rail at the bond terminal over 600 deg. F., the asbestos pulp shall be removed after operation is completed and if inspection shows the bond is not damaged, no further precautions are necessary.

15. If heating operation does increase the temperature of the rail at the bond terminal over 600 deg. F., the following additional requisites shall govern:

(a) Shortly after rails have cooled to normal temperature, the asbestos pulp shall be removed and the bond shall be retightened by a normal blow with proper tools.

(b) In the event bond is damaged to the extent that reliable temporary operation cannot be expected, the bond shall be replaced immediately after the rails have cooled.

(c) Within 60 days after the heating operation has been completed, all bonds shall be removed and scrapped.

(d) If hole is not deformed to prevent bond terminal insertion, the hole shall be retsed after proper cleaning to remove oxidation.

(e) If hole is deformed it shall not be reused and a pair of new holes shall be drilled not less than $\frac{1}{2}$ in. centers from the original holes.

(f) New bonds shall be applied in the proper manner.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Track Welding or Heat Treating in Track
Circuit Territory, Manual Part 156.

(Revision of Requisites for Minimizing the Effect of Foreign
Current on Direct Current Track Circuits)
A.A.R. SIGNAL SECTION REQUISITES.

MINIMIZING THE EFFECT OF FOREIGN CURRENT ON DIRECT CURRENT TRACK CIRCUITS

1950

1. The length of a track section shall be such that the difference of potential between rails with no battery connected will not be sufficient to operate the relay.*
2. One of the following arrangements of track circuits should be used:
 - (a) Short end-fed circuits.
 - (b) Center-fed circuits.
 - (c) Multiple relay circuits.
 - (d) Coded track circuits.
 - (e) Alternating current track circuits.
3. Bonding of crossings of electric railroads shall conform to Drawing _____, dated _____.
4. A separate track circuit shall be installed at either side of an electric railroad crossing.
5. Bonding and return circuit on electric railroads, in the vicinity, should be maintained in first-class condition.
6. Insulated joints should be maintained in first-class condition.
7. Ballast should be kept clear from rails and rail fastenings whenever practicable, and metallic connections from rail to ground should be avoided.
8. Bonding shall be of the low-resistance type and maintained in good condition to insure low resistance.
9. Whenever the source of foreign current can be determined, consideration should be given to placing the track circuit battery at the end nearest the foreign current source.
10. Consideration should be given to the use of:
 - (a) A less efficient d.c. track relay (a relay requiring higher pick-up and release values).
 - (b) A biased neutral relay with polarity opposing the foreign current, providing this is uni-directional.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Minimizing the Effect of Foreign Current on Direct Current Track Circuits, Manual Part 127.

* The interference from an external source bears a direct relation to the length of the circuit. The voltage of the foreign current in the rails is due to the difference of the earth potential at different points. The length of the sections to make them free from foreign current interference depends upon so many factors that no rules can be given as to the length to be used. The length should be shortened generally from the standards used in territory free from foreign current. The length depends also upon the rail resistance.

(Revision of A.A.R. Signal Section Specification 199-44)
A.A.R. SIGNAL SECTION SPECIFICATION 199-50.

ELECTRIC MOTOR MECHANISM AND GATE ARM FOR HIGHWAY GRADE CROSSING SIGNAL

Proposed Revision

8. Gate arm.

(a) The general design and painting of the roadway arm shall conform to Drawing 1491 or 1493. *R-8-a.

(b) The general design and painting of the sidewalk arm, if used, shall conform to Drawing 1492 or 1494. *R-8-b.

(c) The roadway arm shall be equipped on the approach side only with crystal (clear) reflector units in each black stripe. Reflector units shall be $\frac{1}{32}$ in. to $\frac{1}{16}$ in. exposed diameter.

10. Mechanism case.

(a) Mechanism case shall be cast iron in accordance with A.S.T.M. current Specification A 48, or sheet steel, copper-bearing. It shall be weatherproof, and of ample size to properly house, without crowding, the apparatus and wiring contained therein. Doors shall be suitably arranged for convenient and ready access to mechanism. There shall be a ledge over the door to keep water from the joint between the door and the case when the door is closed. Gasket shall be provided between door and case. Means shall be provided for rigidly securing and locking doors of mechanism case.

(b) Mechanism case shall be equipped with at least two ventilation openings properly hooded, one near the top and one near the bottom. Each ventilation opening shall be covered with a wire screen, or equivalent, of non-ferrous metal having openings totaling not less than $\frac{1}{4}$ sq. in. area.

(c) Mechanism case clamped to a mast shall be provided with flexible metallic conduit for protection of electrical connections entering mechanism case. Conduit for control wires shall be not less than 2 inches inside diameter, and equipped with means for making connection to case.

11. Mechanism.

(h) Mechanism clamped to a mast shall be provided with clamps or U-bolts for attaching the entire assembly to 5 in. I.D. standard weight steel pipe. *R-11-h.

20. Purchaser's order.

(a) Purchaser's order shall specify:

2. Length of roadway arm measured from center line of mast to tip, shall be

3. Roadway arm shall be wired without plug connector with light units spaced A, B, C *R-20-a-3.

* Alternate requisites section.

Alternate requisites.

R-8-a.

Roadway arm shall be painted in accordance with Purchaser's Drawing, dated

R-8-b.

Sidewalk arm shall be painted in accordance with Purchaser's Drawing, dated

R-11-h.

Mechanism clamped to a mast shall be provided with clamps or U-bolts for attaching the entire assembly to in. I.D. standard weight steel pipe.

R-20-a-3.

Roadway arm shall be wired with light units spaced A, B, C Plug connector, approved by Purchaser, shall be provided at mechanism end of gate light wires.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 8-a, 8-b, 8-c, 10-a, 10-b, 10-c, 11-h, 20-a-2 and 20-a-3 of Specification 199-44—Electric Motor Mechanism and Gate Arm for Highway Grade Crossing Signal, Manual Part 194.

DEVICES FOR SANDING OF RAIL, OR EQUIVALENT, WHICH WILL REDUCE TRACK CIRCUIT SHUNT FAILURES DUE TO SAND

Representatives of the Mechanical Division, A.A.R. Committees on Brakes and Brake Equipment, Locomotive Construction and Car Construction, and of Signal Section Committee IV, met jointly to investigate and report on devices for sanding of rail, or equivalent, which will reduce track circuit shunt failures due to sand.

A check of reported signal and switch failures over a recent 5-year period on various railroads disclosed that many were caused by loss of shunt of the track circuits due to excessive sand on the rails. The railroads have made studies and tests to improve the shunting sensitivity as much as possible by various methods such as using a higher voltage battery with additional resistance in the circuit at both battery and relay ends, using improved relays or a primary-secondary relay scheme and by using coded track circuits, rectified track circuits or other means.

Laboratory and Track Circuit Shunting Tests of Sands and Mixtures, Reported by One of the Signal Companies

The following tabulation shows the resistance, as measured with a megger, of 18 samples of sand which were submitted for tests. The resistance shown is that of a $\frac{1}{32}$ inch layer of sand held between two $2\frac{1}{8}$ inch diameter brass plates with a weight of $5\frac{1}{2}$ pounds on the upper plate. The fact that some of the samples show a reading of less than infinite resistance is probably due to the sand being a little damp. While there is considerable variation in grain size and appearance of the samples submitted, from the standpoint of shunting track circuits through a film of sand all of the samples have excellent insulating qualities.

Megger Tests of Samples of Sand

Sample No.	(3) tests Megger reading of $\frac{1}{32}$ inch layer of sand between $2\frac{1}{8}$ inch diameter brass plates. Weight of $5\frac{1}{2}$ lbs. on upper plate.	Sample No.	(3) tests Megger reading of $\frac{1}{32}$ inch layer of sand between $2\frac{1}{8}$ inch diameter brass plates. Weight of $5\frac{1}{2}$ lbs. on upper plate.
1	infinite ohms	10	infinite ohms
2	infinite ohms	11	100 megohms
3	infinite ohms	12	infinite ohms
4	infinite ohms	13	8-12 megohms
5	infinite ohms	14*	infinite ohms
6	infinite ohms	15	15-40 megohms
7	100 megohms	16	infinite ohms
8	100 megohms	17	infinite ohms
9	100 megohms	18	infinite ohms

* Several large pieces of rust, which might have been pipe scale, were removed from this sample before testing.

Tests were made to determine if it were possible to run a yard locomotive slowly over a section of sanded rail and show that track circuits with high voltage across the rails would shunt a greater portion of the time than track circuits which had a low voltage across the rails. A recording meter was used to give a record of the total time the track circuit was shunted for each test. A large number of tests showed that track circuits with low voltage across the rails shunted as well as track circuits with high voltage across the rails. Apparently where there were bare spots on the rails, the track circuits would shunt and where there was sand on the rails, the track circuits would not shunt.

The following materials were tested in an effort to find, if possible, some material which was about the same weight as sand and which would produce good shunting when mixed with sand. If some such material were found, it probably would eliminate any difficulty in keeping the material uniformly mixed with the sand. The difficulty of keeping iron particles uniformly mixed with sand might require special means to insure that the iron particles were always delivered with the sand.

A— $\frac{1}{64}$ inch to $\frac{1}{8}$ inch particles of resistor carbon

B—Crushed coke

(1) Particles less than 0.02 inch in size

(2) Particles more than 0.04 inch in size

C—Carborundum (silicon carbide)

D—Abrasive powder #24 grit size

Laboratory tests showed that a $\frac{1}{8}$ inch layer of 0.02 inch to 0.04 inch iron particles held between two $2\frac{1}{8}$ inch diameter brass plates with a weight of $5\frac{1}{2}$ pounds on the upper plate had a resistance of 0.6 ohm. A layer of the same thickness of crushed coke showed a resistance of 0.06 ohm. A $\frac{1}{16}$ inch layer of carborundum #24 grit size showed a resistance of 2,500 ohms at 5 volts and a resistance of 70 ohms after it had broken down at 20 volts.

These laboratory tests indicated that a mixture of crushed coke and sand, or of $\frac{1}{64}$ inch to $\frac{1}{8}$ inch resistor carbon particles and sand, should produce good shunting. However, such was not the case. The particles of crushed coke or carbon particles, when mixed with sand, crushed into powder under the wheels of the locomotive and lost the greater part of their conducting qualities. It was not possible to shunt track circuits with a locomotive through a 5 per cent mixture of carbon particles and sand or a 5 per cent mixture of coke and sand. The 5 per cent mixture of resistor carbon and sand gave better results than a 5 per cent mixture of coke and sand. A yard locomotive standing on a film that consisted of 50 per cent resistor carbon and lake sand showed a shunt resistance of 0.6 to 1.0 ohm when the track circuit was fed from one cell of lead storage battery. The shunt produced by a yard locomotive standing on a film of 100 per cent resistor carbon was not considered to be low enough to produce satisfactory shunting. In these tests no data were taken with regard to adhesive qualities. It was assumed that adhesion would be adversely affected by large percentages of other materials added to the sand.

A yard locomotive standing on a film of pure carborundum #24 grit size crushed the carborundum into powder and the resistance of this shunt on the track circuit varied from approximately 385 ohms with 21.5 volts across the rails to approximately 54 ohms with 52 volts across the rails. This shunt resistance, of course, is much too high to be effective in shunting track circuits.

When iron particles are used in sand, the iron particles are more or less

malleable and flow under the pressure of the locomotive wheels so that the iron particles become flat discs and make good conductors from the wheels to the rails. It appears that any material which is mixed with sand to improve shunting should have the quality of malleability.

Briefly, the results of the tests are as follows:

1. Sand is an excellent insulator even in very thin films.
2. Tests do not show that track circuits using high voltage across the rails are more effective in shunting through a film of sand than track circuits with low voltage across the rails. With the locomotive completely insulated from the rails by a film of sand, none of the types of track circuits which have been developed to date will be shunted. If some of the wheels of the locomotive happen to be on bare spots on the rails, then any track circuit will be shunted.
3. There appears to be no difference between the 18 samples of sand tested in so far as their characteristics are concerned for shunting through a film of sand. All these samples appear to have excellent insulating qualities.
4. Mixtures of particles of crushed coke and sand, particles of resistor carbon and sand, or carborundum and sand are not sufficiently effective in improving the conducting qualities of the sand to be of any practical value from the standpoint of track circuit shunting.
5. Preliminary tests of a mixture of sand and iron particles showed good results from the standpoint of track circuit shunting. The use of this mixture, however, might produce additional problems such as shorting out insulated rail joints and reduction of ballast resistance due to the iron particles.
6. The results of the tests appear to show that it will be impossible to obtain reliable shunting at locations where heavy sanding and operating conditions allow a film of sand to be built up on the rails of the order of $\frac{1}{64}$ inch or more.

Tests to Determine Proper Flow of Sand from Sanders

Satisfactory tests to definitely determine the maximum amount of sand flow from sanders that may be permitted and still not interfere with proper operation of track circuits are impracticable for the following reasons:

1. The thickness of sand deposited on the rails will vary with the various speeds of locomotives.
2. The amount of sand adhering to the rail will vary with the various rail conditions, such as dry rail, wet rail or frosted rail.
3. Varying amounts of sand are required for train operation.

Locomotive Shunting

Tests were made by one railroad to determine the comparative shunting sensitivity of track circuits when shunted by Diesel locomotives and steam locomotives with the following results:

1. The standing shunt resistance in general varied with weight. The greater the weight, the lower the standing shunt resistance. This was true with Diesel and steam engines.
2. With approximately the same weight per axle, the standing shunt resistance of the Diesel engine was higher than that of the steam engine for tests on the same rails, the ratio being an average of approximately 0.00271 ohm for 1 axle of the Diesel and an average of approximately 0.0003726 ohm for 1 axle of the steam engine. The higher shunt resistance of this Diesel was attributed

to car oil dripping from the journal boxes of this Diesel and getting on to the running surfaces of the wheels. This was scraped on to the brake shoes and caused the brake shoes to collect considerable oily dirt.

3. The moving shunt resistance of the Diesel engine was found to be lower than that provided by freight cars passing over a 33-foot section of insulated track.

4. The shunt resistance provided by the Diesel engine for all tests which were made, except under sanding conditions, was well below the maximum allowable train shunt resistance of 0.06 ohm which is recognized as standard by the Signal Section, A.A.R. Excellent shunting was provided by steam and Diesel engines throughout the tests except for the Diesel tests under sanding conditions.

5. The Diesel engine has more sand pipes than the steam engine. It was possible to move this Diesel engine forward slowly sanding the rail and have the first unit stop on sand with the first unit completely insulated from the rails by sand. With the entire Diesel engine moving approximately 10 miles per hour over the 670-foot insulated section of track sanding the rail, in this case, provided a low resistance shunt across the track.

Locomotive Sanding System

The recommended practice of the Mechanical Division, A.A.R., for steam, Diesel and electric locomotive sanding system, adopted in 1943 is as follows:

"1. Sand pipes to be 1 inch extra heavy when applied at each wheel or $1\frac{1}{4}$ inches extra heavy if not applied at each wheel.

"2. Rate of sand delivery per sand pipe 1 lb. per minute on engines having sand pipes applied at each wheel, with maximum of $3\frac{1}{4}$ lbs. per minute on locomotives where sand pipes are not applied at each wheel.

"3. On drivers equipped with lateral motion device or lateral cushioning device, sand pipes should be provided with flexible arrangement so that sand pipes can follow driver when taking curve."

The locations of sand pipes for forward and backward motion for different driving wheel groups recommended by the Mechanical Division are shown diagrammatically for steam, Diesel and electric locomotives in the Mechanical Division Manual, Section F, pages 238, 239 and 240. This information is based on replies to a questionnaire and was adopted without discussion in 1943 because no Annual Meeting was held that year.

Interstate Commerce Commission Requirements

The Interstate Commerce Commission requires a minimum clearance of $2\frac{1}{2}$ inches between sand pipe and rail.

Adjustment of Commercial Sanders

All commercial sanders furnished the railroads can be adjusted to deliver 1 to 3 pounds of sand per minute per trap. Many of these commercial sanders now in service have been altered to increase the flow beyond 3 pounds per minute but can be changed to limit the delivery of sand to a maximum of 3 pounds per minute per trap at nominal expense. At present the flow of sand from existing sanders on steam locomotives is known to vary from 1 to 24 pounds per minute.

*Improvements in Sanding Devices**Traction sanders.*

There is now available a sanding device for use on locomotives which uses a comparatively small amount of sand. The amount of sand used can be regulated to about $1\frac{1}{2}$ pounds per minute. The report is that with the use of this device the sand remaining on the rail after the engine has run over the sanded track is scarcely noticeable.

The sand is delivered through a $\frac{1}{2}$ -inch nozzle mounted at such an angle that the sand is blown into the point of contact between the wheel and rail. The device is under the control of the engineman and employs main reservoir air to blow the sand through the nozzle. Nozzles are provided for sanding for reverse as well as forward movement. Sharp sand must be used.

One railroad has several locomotives equipped with the device and has made a test of the effect of application of sand on a track circuit 875 feet long equipped with a 2-ohm relay.

The locomotive used had a wheel arrangement of 4-8-4 and was equipped with six sand nozzles, one ahead of each of the first and second pair of driving wheels and one nozzle on each side for reverse movements. The following results were obtained:

	Current to rail, ampere	Rail voltage battery end, volts	Current to relay, ampere	Rail voltage relay end, volt
Unoccupied.....	0.370	1.1	0.316	0.60
Engine standing. No sand.....	0.650		0.0	0.0
Engine moving and standing.....	0.650		0.0	0.0
Engine stopped. All wheels on sanded track.....	0.650		0.0	0.0

Braking sanders.

One railroad reports that on Diesel-powered streamliners they have been installing on each car a sanding device to prevent sliding of wheels when braking.

Sand nozzles are located on each side of the car mounted at such angle as to apply the sand by air pressure at the point of contact of the first wheel of the rear truck with the rail. The sanding is entirely independent and automatic on each car.

A decelostat valve is installed in the brake cylinder pipe between the relay valve which supplies air to the brake cylinders, and the brake cylinders themselves. Normally, the decelostat valve does not interrupt the flow of air to or the exhaust of air from the brake cylinders during brake applications and releases. When the wheels slip, the decelostat valve causes a momentary release of braking pressure on the wheels involved and initiates sanding which continues after each initiation for a timed period and is automatically terminated.

This railroad states that a very small amount of sand is used, that sliding wheels are a rarity and there has been no track circuit failure due to sand on the rail.

Another railroad reports the use of similar equipment on their streamliners, the differences being in the equipment which initiates the sanding, and provision for sanding is for one direction only.

The use of braking sanders is further discussed in an article entitled "Wheel

Slip and Passenger-Train Braking" appearing on page 40 in the December 31, 1949 issue of *Railway Age*. Of particular interest is a paragraph in this article which relates to a practice of sanding in emergency at each truck, reading:

"In this system, sanding is automatically initiated at every truck station under an emergency application, irrespective of the rail conditions. Because of the infrequency of emergency applications and the benefits derived from advanced sanding (when required), the waste attending those occasions not requiring assistance can easily be justified. This manner of sanding has been adopted on various main-liners, and appears to be winning favorable acceptance."

Sanding Equipment Used on Diesel Locomotives

Manufacturing development.

The development of the present sanding equipment used on Diesel locomotives is a result of several years testing. Early experimental sanding equipment was available which incorporated the desired improvements that experience had indicated was necessary. A series of tests were made on equipment known as single-line sanding, compared with the previous double-line sanding. With the double-line sanding a "slug" of sand was laid down with the initial sander valve operation and each subsequent manipulation of the sander valve would lay down an additional "slug" of sand and the clean-out blast would result in a further quantity of sand being laid on the rail. With the single-line sanding equipment as presently used, a uniform volume of sand is laid down for each application.

The major design changes are as follows:

1. The clean-out function was taken out of the operating valve in the cab and an automatic timed cleanout was provided in the relay through "one line" to the sand trap. This change requires the use of relays in order to prevent a pyramiding of sand on the rail after successive manipulations of the operating handle in the cab and to provide equal sanding for all wheels in multiple unit operation.

2. The relay valves were changed to eliminate a separate clean-out pipe which injected air in the sand trap, causing turbulence and slugging or pumping of sand into the delivery pipe.

3. The sand delivery pipe was decreased in size from $1\frac{1}{4}$ inches to 1 inch. This reduction in the cross-sectional area of the delivery pipe increased the air velocities and resulted in reduction of the quantity of flow. The increased velocity was required to hold the sand in suspension in order to direct the sand to the point of contact between the wheel and the rail and minimize the effect of locomotive speed and cross-wind velocity. The increased velocity which resulted in more effective delivery of sand to a point of contact between the wheel and the rail also resulted in reduction in the quantity of sand used for effective sanding.

A survey was then conducted to determine the minimum quantity of sand required in the various types of service, and the following results were obtained:

Service	Sand delivery rate
Passenger service.....	1 to 2 lbs. per minute
Freight service.....	1 to 2 lbs. per minute
Switching service.....	$1\frac{1}{2}$ to $2\frac{1}{2}$ lbs. per minute

Based on the above, the equipment of various manufacturers of sanding equipment was tested to determine the characteristics using 135 pounds air pressure and all equipment was capable of being adjusted to deliver from 1 to 3 pounds of sand per minute.

The following secondary advantages have resulted from the newly designed equipment:

1. The reduction in delivery rate has resulted in the use of less quantity of sand and minimum sand left on the rail.
2. Based on the maximum delivery rate of single-line equipment and the average requirements, the capacity of sand boxes will provide adequate storage for operation between extended servicing periods.

Railroad tests.

Following the receipt of complaints on one railroad that sand laid down by Diesel-electric switching locomotives prevented proper operation of signals, a campaign was made to adjust the delivery within a range that would prevent such an accumulation of sand on the rails. Not being entirely successful with the sanders with which the locomotives were equipped, arrangements were made for test applications of a high velocity sander and representative reports on the performance of these test applications were as follows:

In test with 1,000 horse power Diesel-electric yard engine equipped with high velocity sanders, the engine moved past signal "A" two engine lengths, made two reverse movements, or four one-way movements with sander valve open and maximum sand flow, and signal remained red indication. A layer of crushed sand too thin to produce flakes remained on top of rail, and just enough sand to easily make a mark in the layer of sand dust with gloved finger.

Tests made with 1,500 horse power road switcher having high velocity traps and delivery nozzles and delivery ahead and rear of each truck were as follows:

Test No. 1—Locomotive cut loose from train and moved at 10 miles per hour with maximum sanding. Signal indicated yellow, and as locomotive moved forward the signal changed to red indication before locomotive cab passed signal. Locomotive stopped and moved back out of block full sanding for reverse move.

Test No. 2—Signal indicated yellow. Locomotive moved into block at 5 miles per hour with full sanding forward, and signal changed to red indication before locomotive cab passed signal.

Test No. 3—Same movement as Test No. 2, except speed reduced to approximately 2 to 3 miles per hour. With signal indicating yellow, locomotive moved forward at this speed with full sanding forward, and signal changed to red indication before locomotive cab passed signal.

Test No. 4—Same movements as previous tests, except speed reduced to 1 to 2 miles per hour. Moving into the block with full sanding forward, the signal changed to red indication before the locomotive cab passed signal.

Rail was examined following each test, and sand delivered to rail was found crushed to light powder. The rail was entirely dry.

Test No. 5—Locomotive with train was slowed down to 2 to 3 miles per hour, on hill approaching signal. Developing nearly full traction and with full sanding, the signal changed from yellow to red indication before the locomotive cab passed the signal.

Calibration of sand delivery of this locomotive developed the following:

Right #1 sander.....	1 $\frac{3}{4}$ lbs. per minute
Right #2 sander.....	1 $\frac{1}{2}$ lbs. per minute
Right #3 sander.....	1 $\frac{7}{8}$ lbs. per minute
Right #4 sander.....	1 $\frac{1}{8}$ lbs. per minute
Left #1 sander.....	1 $\frac{1}{4}$ lbs. per minute
Left #2 sander.....	1 $\frac{5}{16}$ lbs. per minute
Left #3 sander.....	1 $\frac{1}{2}$ lbs. per minute
Left #4 sander.....	1 $\frac{1}{2}$ lbs. per minute

This high velocity sander conditions the rail for good traction with a delivery of 1 $\frac{1}{2}$ to 1 $\frac{3}{4}$ pounds per minute per trap. The high velocity is an important factor in preventing the building up of sand on the rail.

Sanding Equipment Used on Steam Locomotives

In connection with the operation of steam locomotives, the ever increasing needs for maintaining adequate adhesion between the locomotive wheels and the rails, especially when starting from rest or while ascending grades with heavy train loads or when abnormal rail conditions are prevalent, have made it imperative that sanding equipment for locomotive traction purposes be given study to improve the sanding efficiency and effectiveness with resulting economy in the use of air and reduction in the required quantity of sand delivered to the point of wheel and rail contact without leaving excessive sand on the rail which might interfere with proper signal operations.

Recommendations

With the present development of high velocity sanders that have positive adjustment for sand delivery of 1 to 3 pounds per minute, as desired, it is considered the situation with respect to excessive delivery of sand may be substantially improved on new locomotives, and that the sanding equipment on existing locomotives can be altered to give this improved delivery at a nominal cost.

The use of clean, dry sand of a sharp grain will minimize operating failures, reduce maintenance costs, and permit the adjustment of the trap nozzle to minimum feed or delivery. The railroads generally may effect considerable economy and improved operation of sanders by more careful attention to the quality of the sand being used. It is common practice to purchase sand locally wherever possible and, in the absence of specifications, this may be coarse river sand, sharp lake sand, dune sand, bank sand, sea sand or sand with fine gravel.

It is recommended that the Specification for Locomotive Sanding System in the A.A.R. Mechanical Division Manual of Recommended Practice be revised and brought up-to-date and that a specification for locomotive sand be included. In revising the specification, the following features should be given consideration to avoid failures of signals and switches to operate as intended

because of loss of shunt of the track circuits due to excessive sand accumulations on the rails:

1. The least amount of good quality sand required for train operation should be used.

2. The method of applying sand should be by air pressure with nozzle of sander directing the sand to the point of contact of wheel with rail.

3. The minimum volume of sand should have sufficient velocity to directly reach point of contact of wheel and rail.

4. Maximum size of sand pipes should be 1 inch and sand pipes should be so located that sand is most efficiently delivered to the point of contact between the wheel and rail.

5. Sand pipes should be so installed and maintained as to provide minimum clearance of $2\frac{1}{2}$ inches between nozzle and rail to comply with requirements of the Interstate Commerce Commission.

6. While some railroads have used brushes or blowers on the locomotive for the purpose of removing excessive amounts of sand from the rails after each application it is quite probable that other railroads might find such installations too expensive both on first cost and on maintenance.

7. Rail washers are satisfactory in territory not subject to freezing temperatures. They are, however, impracticable on some locomotives such as the Diesel type having limited water supply.

It is further recommended that the railroads conduct a campaign in the education of enginemen in the proper use of sand especially at places where operation of the signal system could be affected. It is suggested that the Signal Section progress a further study in an effort to overcome the effect of sand on the rails at points where locomotives are changed and at yard leads and other places where heavy switching is done.

Action Recommended

Acceptance as information.

(Revision of A.A.R. Signal Section Specification 160-39)
A.A.R. SIGNAL SECTION SPECIFICATION 160-50.

CAPACITOR FOR POWER FACTOR IMPROVEMENT

1. *Purpose.*

(a) This specification is for the purpose of providing a capacitor for power factor improvement of railway signal power distribution circuits. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Drawings.*

(a) Purchaser's drawings referred to in this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. *Tender.*

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. *Alternates.*

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

6. *Type.*

(a) Capacitor shall be designed for indoor or outdoor service as specified.

(b) Capacitor shall be equipped with suitable hangers or feet for cross-arm, wall or shelf mounting, as specified.

7. *Rating.*

(a) Capacitor for power factor improvement on signal power distribution circuits other than those in signal apparatus housings shall be rated in accordance with N.E.M.A. current Standards for Shunt Capacitors.

(b) Capacitors for use in signal apparatus housings shall be rated in microfarads, voltage and frequency. They shall be suitable for continuous operation at circuit voltage and frequency in an ambient temperature not to exceed 150 deg. F.

(c) Capacitors for use in signal apparatus housings shall be derated in accordance with the following table:

7. *Rating.*—Continued.

Commercial 60 cycle voltage rating	Derated maximum continuous circuit voltage at 60 cycles or lower frequency
330	125
440	250
660	500
750	600

Voltage rating on name plate shall be as shown in the second column above.

8. *Design.*

(a) For use other than in signal apparatus housings:

1. Capacitor for power factor improvement on signal power distribution circuits other than those in signal apparatus housings shall be in accordance with N.E.M.A. current Standards for Shunt Capacitors.

(b) For use in signal apparatus housings:

1. Capacitor shall consist of one or more sections comprising metal layers separated by insulating material, impregnated in a fluid insulating and cooling medium and housed in a hermetically sealed metal container filled with the same fluid.

2. Capacitor assembly shall be securely mounted and rigidly held in place in the container to prevent movement of parts due to vibration.

3. Metal container shall be constructed of not less than No. 28 A.W.G. heavily tinned sheet steel, or its equivalent, sealed against all possibility of leaks and protected by moisture-resistant paint.

4. Capacitor unit shall be sealed in such manner as to remain moisture-proof and air-tight over a temperature range of minus 30 deg. F. to plus 150 deg. F.

5. Capacitor shall be of such design as to have not less than 90 per cent nor more than 110 per cent of the rated capacitance at 77 deg. F., plus or minus 9 deg. F.

6. Capacitors shall be of such design that the maximum allowable power factor as measured with the capacitor at a temperature of 77 deg. F., plus or minus 9 deg. F., and at rated voltage and 60 cycle frequency, shall not exceed 0.6 per cent.

7. The minimum insulation resistance shall not be less than 1,500 megohm microfarads at 77 deg. F., plus or minus 9 deg. F., after 2 minutes electrification time at 500 volts d.c.

9. *Terminals.*

(a) Capacitors for power factor improvement on signal power distribution circuits other than those in signal apparatus hous-

9. *Terminals.*—Continued.

ings shall be equipped with terminals in accordance with N.E.M.A. current Standards for Shunt Capacitors.

(b) Binding posts, nuts and washers for capacitors for use in signal apparatus housings shall conform to Drawing 1070, detail 107010. Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.
*R-9-b.

10. *Dielectric requirements.*

(a) Capacitors for power factor improvement on signal power distribution circuits other than those in signal apparatus housings shall be tested in accordance with N.E.M.A. current Standards for Shunt Capacitors.

(b) Capacitors for use in signal apparatus housings shall be capable of withstanding the following tests:

1. Terminal to terminal.

(a) Capacitors shall be capable of withstanding at place of manufacture the following tests at 60 cycles for 1 minute:

Rated voltage	Test voltage
125	750
250	1,000
500	1,500
600	1,700

2. Terminal to case.

(a) Capacitors shall be capable of withstanding a terminal to case test at place of manufacture of 3,000 volts at 60 cycles for 1 minute.

11. *Name plate.*

(a) Name plate data shall be permanently and legibly applied to each capacitor.

(b) Capacitors for power factor improvement on signal power circuits other than those used in signal apparatus housings shall have name plate marking in accordance with N.E.M.A. current Standards for Shunt Capacitors.

(c) Capacitors for use in signal apparatus housings shall have name plate marking as follows:

1. Manufacturer.

2. Identification number or type, model, style or catalogue number.

3. Capacitance in microfarads.

4. Rated voltage.

5. Frequency.

* Alternate requisites section.

12. *Purchaser's order.*

(a) Purchaser's order of capacitors for power factor improvement on signal power circuits other than in signal apparatus housings shall specify the following requirements which shall be met:

1. Frequency.
2. Voltage rating.
3. Phase and type of connection.
4. Kv-a. rating.
5. Indoor or outdoor service.
6. Type of mounting, if required.
7. Tests required, if any, in addition to Manufacturer's production tests.

(b) Purchaser's order of capacitors for use in signal apparatus housings shall specify the following requirements which shall be met:

1. Frequency.
2. Voltage rating.
3. Microfarad rating.
4. Types of mounting, if required.
5. Tests required, if any, in addition to Manufacturer's production tests.

13. *Inspection.*

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

14. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

15. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

16. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

17. *Warranty.*

(a) Manufacturer shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-9-b.

Capacitors for use in signal apparatus housings shall be provided with screw type binding posts suitably insulated from the container, with 10-32 or 12-24 threads and so applied that they cannot be turned.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 160-39—Capacitor for Power Factor Correction,
Manual Part 100.

(Revision of A.A.R. Signal Section Specification 78-39)
A.A.R. SIGNAL SECTION SPECIFICATION 78-50.

ALTERNATING CURRENT INDUCTION TYPE RELAY

1. Purpose.

(a) This specification is for the purpose of providing an alternating current induction type relay for control of signals and interlocking apparatus and vital circuits of first, second or third voltage range alternating current, or first voltage range direct current. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. Drawings.

(a) Purchaser's drawings referred to in this specification form an essential part hereof.

(b) Manufacturer shall furnish with his tender, drawings forming an essential part thereof.

3. Tender.

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. Alternates.

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

6. Design.

(a) Relay shall be of a design approved by the Purchaser.

(b) All moving parts shall be enclosed in a case which, with the exception of the screened breather in the bottom provided by section 6-c, shall be dust and moisture-proof under service conditions. The case shall be so constructed that the operated parts within shall be readily visible for inspection without opening the case. Case shall be so secured that a minimum clearance of $\frac{1}{8}$ in. exists between it and all moving parts. If metal corner posts are used, they shall be so constructed as to securely hold the glass sides and adequately support the top.

(c) A screened breather opening, in base of case, adaptable for closing, shall be provided. *R-6-c.

* Alternate requisites section.

6. Design.—Continued.

(d) All nuts and screws shall be securely locked.

(e) Operating mechanism and contact elements shall be so secured or designed that they cannot be damaged or lose adjustment during shipment.

(f) Relay shall be sealed at the factory so that no adjustment can be made without first breaking the seal.

7. Clearance.

(a) Under the most unfavorable conditions of play and relative position of parts in the assembled relay, all moving parts except bearings and contacts shall be separated by not less than the following minimum clearances:

1. Radial..... 0.020 in.

2. Longitudinal..... 0.017 in.

3. The minimum end play of the moving element shall be 0.010 in., and maximum..... 0.020 in.

*R-7-a-3.

(b) The stop to limit the motion of the mechanism when the relay is energized shall be of corrosion-resisting material and shall be so designed as not to restrain the free movement of the mechanism to the de-energized position.

8. Windings.

(a) Soft-drawn copper wire not smaller than No. 34 A.W.G. and preferably not smaller than No. 30 A.W.G. shall be used in the winding.

(b) Terminal leads of winding shall be insulated and of strands of tinned copper not larger than No. 28 A.W.G.; the aggregate cross-section shall be not less than that of a No. 20 A.W.G. wire.

(c) Windings shall be plainly marked with Manufacturer's reference.

9. Pivots and bearings.

(a) Material for pivots or link pins shall be hard-drawn bronze nickel-silver not less than 18 per cent nickel, stainless iron or steel, or other suitable corrosion-resisting material.

(b) Material for bearings should be different from the associated pivot and shall be corrosion-resisting metal or agate, sapphire, or other suitable natural or synthetic jewel securely fastened in a holder of brass or other corrosion-resisting material.

(c) All pivots and bearings shall be of such design and so manufactured and assembled that they do not offer appreciable frictional resistance. If cylindrical pivots are used, they shall be not smaller than 0.055 in. diameter, nor larger than 0.165 in. diameter, and shall have adequate clearance in the bearings so that no binding can develop in normal operation. Bearings for the armature shaft shall be not less than 0.002 in. larger in diameter than the pivots.

* Alternate requisites section.

10. Contacts.

(a) Contacts in normal operation shall meet fixed contact surfaces squarely and simultaneously within 0.005 in. total variation and make a wiping contact and shall exert a pressure of not less than 0.5 ounce per contact and be compressed at least 0.020 in.

(b) Contacts of the metal to carbon type shall be so designed that they cannot be mechanically locked or fused by lightning or an abnormal flow of current in service.

(c) The resistance of cleaned front, normal, or reverse contacts, when relay is energized at working current or voltage, shall not exceed the following values per contact:

- | | |
|--------------------------|----------|
| 1. Metal to metal..... | 0.03 ohm |
| 2. Metal to carbon..... | 0.09 ohm |
| 3. Carbon to carbon..... | 0.20 ohm |

(d) The resistance of cleaned back or de-energized contacts, when relay is de-energized, shall not exceed the following values per contact:

- | | |
|--------------------------|----------|
| 1. Metal to metal..... | 0.03 ohm |
| 2. Metal to carbon..... | 0.18 ohm |
| 3. Carbon to carbon..... | 0.40 ohm |

(e) Contacts shall be so adjusted that in their open position there shall be not less than 0.050 in. space between the fixed post and the contacting point, for the first and second voltage ranges, and not less than 0.090 in. for the third voltage range. The minimum front and back contact opening with the front or back contact just closed shall be 0.020 in.

(f) All parts of the contact fingers (other than the contact point), including its flexible connections and the post to which the connector is attached, shall be separated by at least 0.10 in. from any other metal or conducting part of the relay.

(g) Contacts shall be capable of breaking 10 amperes at 115 volts a.c. or 5 amperes at 230 volts a.c.

(h) The continuous current-carrying capacity of contacts shall be 2 amperes for carbon to carbon contacts, 4 amperes for metal to carbon contacts, or 7 amperes for metal to metal contacts.

(i) Metal supports for carbon contacts shall not exceed within $\frac{3}{64}$ in. of the contact surface.

11. Flexible connections.

(a) The flexible conductor connecting the binding post and contact finger shall be so formed and attached as not to affect operation of the movable elements. This conductor shall be of a section to carry 10 amperes continuously without injury.

12. Binding posts.

(a) Binding posts shall conform to Drawing 1070, detail 107010, and shall be so mounted that they cannot turn in the base or frame to which they are fastened.

12. *Binding posts.*—Continued.

(b) Binding posts supporting the fixed parts of front and back contacts shall be fastened in their supports so as to preclude adjustments of any kind without first breaking the seal of the relay.

(c) Binding posts shall be spaced with not less than 1 in. centers.

13. *Winding insulation.*

(a) Windings shall be wound with insulated wire and treated so as not to be injuriously affected by atmospheric conditions or by changes in temperatures between 40 deg. F. below zero and 185 deg. F. above zero.

1. Enameled wire shall be in accordance with Specification 193, Manual Part 183.

2. Cotton-covered wire shall be in accordance with Specification 194, Manual Part 189.

3. Silk-covered wire shall be in accordance with Specification 195, Manual Part 200.

(b) Windings external to the housing of moving parts shall be impregnated by vacuum and pressure with insulating compound in accordance with Requisites for Compound for Impregnation of Electrical Windings, Manual Part 171.

(c) Windings adjacent to moving parts, air gaps, or contacts shall be treated by impregnation, dipping, or brushing with insulating varnish in accordance with Requisites for Varnish Treatment of Electrical Windings, Manual Part 174.

(d) When enamel insulation on No. 16 A.W.G. wire or smaller is used on impregnated coils, a cotton thread shall be placed between layers and built up at each end to a minimum wall thickness of $\frac{1}{16}$ in.

(e) Insulating material used for fillers in windings shall be chemically neutral.

(f) Windings shall be so insulated that they will withstand the insulation test provided by section 14. Individual coils shall be given this test by mounting coil on a snugly fit metal mandrel and making breakdown tests between mandrel and winding; also by standing coil on each end in turn on a metal plate and testing between plate and winding.

(g) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.

14. *Dielectric requirements.*

(a) Electrical apparatus assembled shall withstand for one minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom.

(b) A surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

14. *Dielectric requirements.*—Continued.

(c) Separate windings, which are insulated from each other, shall withstand for one minute an insulation test of 3,000 volts a.c. between their terminals.

(d) A potential of twice the normal operating requirements at a suitable frequency shall be impressed across the windings without any excessive flow of current indicating a short circuit.

(e) Material used as insulation for binding posts or contact fingers shall not be affected by moisture or change in temperature between 40 deg. F. below zero and 185 deg. F. above zero.

15. *Purchaser's order.*

(a) Purchaser's order shall specify:

1. A.C. voltage and the frequency on which the relay elements shall operate.
2. Voltage and current of the circuit or circuits controlled by the relay.
3. Contact arrangement.

16. *Operating characteristics.*

(a) The contacts closed with the relay energized shall open from the fully energized position by a gradual reduction in voltage or current at a value which shall be not less than 50 per cent of the value required to just close the contacts. In case of two-element relays this test shall be made by reducing the energy on the control element only, the voltage on the local element being maintained at constant rated value.

(b) The voltage or current required to make contact shall be not less than 35 per cent of the value required to bring the contacts to their rated pressure. In case of two-element relays this test shall be made by varying the energy on the control element only.

(c) For two-element track relays the above readings shall be made either with ideal phase relation between the currents in the two elements, or at a stated phase relation with suitable correction to establish the values at ideal phase relation if desired.

(d) For two-element line relays the above readings shall be made with inherent phase relation between the currents in the two elements.

(e) Line relay shall perform satisfactorily when the voltages on all elements are reduced to 85 per cent of their rated values.

(f) The movable part of the mechanism shall develop a total gravity bias of 2 ounces or more, measured at the front contacts and with the front contacts just open.

(g) It shall not be possible for the mechanism to be held in a position with the front contacts closed by steady direct current in the windings.

17. *Finish.*

(a) Metal parts shall be protected against corrosion with suitable plating in accordance with Specifications for Metallic Coating of Metals, Manual Part 63, or other suitable protective coating except where such protection may interfere with the proper operation of the relay.

1. Zinc or cadmium plating shall not be used on any current-carrying parts or on any parts within the enclosure of the relay, except base plate and corner posts. *R-17-a-1.

(b) Material used for protection against corrosion shall neither melt nor flake under ordinary conditions between temperatures of 40 deg. F. below zero and 185 deg. F. above zero.

18. *Name plate.*

(a) Each relay shall bear in a conspicuous location a metal plate on which shall be stated:

1. Manufacturer's name.
2. Type.
3. Manufacturer's reference number.
4. Serial number.
5. Frequency.
6. Rated volts for each element.

19. *Sealing and calibration.*

(a) The enclosure containing the moving parts of the relay shall be sealed with Manufacturer's seal.

(b) Each relay shall bear a paster in a conspicuous place inside the glass cover on which shall be stated:

1. Manufacturer's reference number.
2. Serial number.
3. Local element (for two-element relay):

(a) Volts and amperes.

4. Control element operating values (for two-element track relays only, these values are to be for ideal phase relations) (*R-19-b-4):

(a) Pick-up volts and amperes.

(b) Working volts and amperes.

(c) Drop-away volts and amperes, or as a percentage of pick-up. (Drop-away for an a.c. relay is defined as the value at which the front contacts open when the current is gradually reduced from the normal value, Manual Part 124, Instruction 26-c.)

5. Identification of tester.
6. Date tested.

* Alternate requisites section.

20. Inspection.

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Manufacturer, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Manufacturer shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

21. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Manufacturer shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Manufacturer shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

22. Packing.

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

23. Marking.

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

24. Warranty.

(a) Manufacturer shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Manufacturer's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-6-c.

A breather opening shall not be provided.

R-7-a-3.

The minimum end play of the moving element shall be
..... in., and maximum in.

R-17-a-1.

Zinc or cadmium plating shall not be used on any current-carrying parts or on any parts within the enclosure of the relay, except base plate and corner posts. Zinc or cadmium plating as an under coat for a final coating of tin may be used on other than current-carrying parts.

R-19-b-4.

Control element operating values (for two-element track relays only, these values are to be for phase relations).

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 78-39—Alternating Current Relay,
Manual Part 122.

PROTECTION AGAINST LIGHTNING

Previous report* on this assignment included a diagram, Fig. 1, indicating recommended practice for maximum protection against lightning.

Figure 1, revised and presented herein, represents maximum protection against lightning. Additions to original Fig. 1 are as follows:

1. Overhead ground wires extending several poles either side of transformer location.
2. Where steel relay case or house is used, connect to ground.
3. Connect signal mast to ground.

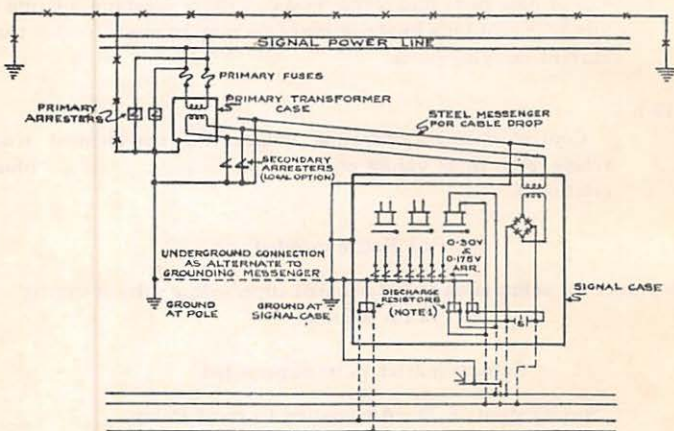


FIG. 1

— — — — — OVERHEAD GROUND WIRE EXTENDING SEVERAL POLES
EITHER SIDE OF TRANSFORMER LOCATION AND
GROUND CONNECTION (LOCAL OPTION)

NOTE:1 - DISCHARGE RESISTORS MUST HAVE AN INVERSE RESISTANCE-CURRENT CHARACTERISTIC SO THAT THEY WILL NOT PASS AN APPRECIABLE AMOUNT OF CURRENT AT SIGNAL VOLTAGES BUT WILL PASS LARGE AMOUNTS OF LIGHTNING DISCHARGE CURRENTS WITH RELATIVELY LOW IR DROP.

* A.A.R. Signal Section 1939 Proceedings, Vol. XXXVII, pp. 174 and 595.

Replies to questionnaire (Inquiry SS-85A) issued to Voting Representatives of Member Roads in the Signal Section on February 3, 1949, show that some or all the methods covered are being followed in most cases, the extent being indicated by the following tabulation:

	Not used		Tried at some locations		Used extensively	
	R.R.	Votes	R.R.	Votes	R.R.	Votes
1. Overhead shield wire.....	57	700	12	155	6	137
2. Connection between steel relay case and ground bus.....	21	212	8	119	46	679
3. Connection between signal mast and ground bus at relay case.....	53	721	6	166	15	121
4. Transformer secondary arresters at transformer.....	65	691	7	100	14	201
4a. Transformer secondary arresters in signal case.....	21	158	1	15	52	823
5. Steel messenger used to interconnect transformer pole ground to ground bus at relay case.....	64	602	2	45	6	59
5a. Underground wire connection between transformer pole ground and ground bus at relay case.....	57	494	16	310	11	204
6. Track discharge resistors.....	56	591	6	85	10	302
6a. If you use track discharge resistors, do you also use shunt arresters (con- nected across track leads)?.....	47	557	4	48	5	221
6b. Track arresters (connected between track leads and ground bus).....	16	166	7	74	53	758
6c. If you use track arresters, do you also use shunt arresters (connected across track leads)?.....	34	433	12	118	23	318
6d. Shunt arrester on track leads without track discharge resistor or arrester.....	56	612	2	24	15	317

Inquiry SS-85A also requested information regarding the value of each of the methods listed in the tabulation. If the Voting Representative answering the questionnaire had tried the scheme, he was to show whether, in his opinion, it provided good, fair, or poor protection, and the type of arrester used in applying the scheme (valve, gap, rare gas, electrolytic, etc.). He was further asked to indicate whether he would use this scheme for new work. In general, the replies indicated that on railroads using a method extensively, the protection provided by that method was considered to be good and its use would be continued for new work.

Except for manufacturing improvements in the various types of arresters, the Committee has found no new developments in the protective devices and, except for some novel methods of application in specific installations, the basic ideas indicated by revised Fig. 1 are being followed.

A number of railroads advise that where very severe lightning occurs they have almost entirely eliminated adverse effects by the use of total protection

indicated, and that it is their present standard to extend the use of this total protection as fast as conditions permit.

A number of railroads advise they have no high-voltage lines and lightning is not severe in their territories, so that a minimum use of protective devices is giving excellent service. The Committee has other information which indicates that some areas are practically free from severe lightning and that compass direction, rivers and hilly country all have a relation to the amount of lightning which will occur. Obviously these conditions are local and should be given such consideration as experience indicates.

Conclusion

1. That the method indicated in Fig. 1 represents the best practice for maximum protection against lightning.
2. That in a system which does not require all the devices indicated, the methods shown will furnish most protection from such device as are used.
3. That the interconnection of all grounds and the provision of a discharge path which includes the rail connections will provide a maximum of protection at a minimum expense.

Action Recommended

Acceptance as information.

(Revision of A.A.R. Signal Section Specification 162-43)
A.A.R. SIGNAL SECTION SPECIFICATION 162-50.

COLOR POSITION LIGHT SIGNAL

1. Purpose.

(a) This specification is for the purpose of providing a color position light signal. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. Drawings.

(a) Purchaser's drawings referred to in this specification form an essential part hereof.

(b) Contractor shall furnish with his tender, drawings forming an essential part thereof.

3. Tender.

(a) The tender shall be for material, design and assembly meeting the requirements of this specification in its entirety.

4. Alternates.

(a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

5. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

6. Design.

(a) The general design, dimensions and structure of signal shall conform to Purchaser's drawings.

(b) Detail design of signal shall be approved by Purchaser.

(c) Like parts of same Manufacturer's apparatus shall be interchangeable.

7. High signal.

(a) High signal shall be a combination of electric light units, the main group of which shall have the units located on a 14 in. radius.

(b) Auxiliary units shall be mounted 7 ft. above or below and in a vertical line with center of main group or offset 3 ft. 4 in. from a unit so mounted.

(c) Electric light units shall be mounted on backgrounds to provide the aspects as specified.

(d) Electric light units shall be mounted in such a way that they may be adjusted individually in order to procure the alignment which will provide satisfactory signal indications.

8. *High signal backgrounds.*

(a) Main group background shall conform to Purchaser's drawing, shall be not less than 40 inches in diameter and shall be designed to accommodate maximum number of 8 electric light units. Unused spaces shall be covered with a suitable metallic plate which may be readily removed.

(b) Background for auxiliary electric light units shall be not less than $18\frac{1}{2}$ inches in diameter and shall conform to Purchaser's drawing.

(c) Background shall be made of boiler plate of a thickness not less than $\frac{3}{16}$ in. *R-8-c.

9. *High signal electric light units.*

(a) Electric light unit cases shall be cast iron in accordance with A.S.T.M. current Specification A 48, Class 20. They shall be weatherproof and equipped with suitable doors or covers. The doors or covers, when opened, shall provide easy access to all parts. *R-9-a.

(b) The doors or covers of electric light units shall be so arranged that, when left open, daylight from the back of the signal will not cause a less restrictive indication than that intended to be displayed.

(c) Electric light units shall be of such design and construction as to prevent undesirable reflection of external light.

(d) Lamp receptacles shall be adjustable and electric light units shall be provided with means to check that lamp filament is in proper focal point of lens.

10. *Terminal box for high signals.*

(a) Main group of electric light units shall be provided with a weatherproof cast-iron terminal box which shall conform to Purchaser's drawing. *R-10-a.

(b) Wires from electric light units shall be brought to terminals in the terminal box as shown on wiring diagram which is to be located in a conspicuous place in the box.

11. *Dwarf signal.*

(a) Dwarf signal main and auxiliary cases shall be cast aluminum alloy in accordance with A.S.T.M. current Specification B 26, Alloy CS-22 or S-2. It shall be weatherproof and provided with maximum number of lamp compartments in main group and bottom auxiliary group and shall conform to Purchaser's drawing.

(b) Lamp compartments shall be separated by light-proof barriers.

* Alternate requisites section.

11. *Dwarf signal.*—Continued.

(c) Dwarf signal shall be so arranged as to provide the aspect specified. Unused lens openings shall be covered with waterproof cover of same material as case, secured in place by same method as is used for securing lenses and hoods.

(d) Terminal boards shall be so located as to be easily accessible and shall have binding posts in accordance with section 20.

(e) Lamp receptacles shall be adjustable and lamp compartment shall be provided with means to check that lamp filament is in proper focal point of lens.

12. *Electric lamps.*

(a) Electric lamps shall be in accordance with Specification 51, Manual Part 91.

(b) Rating of electric lamps shall be as follows: $13\frac{1}{2}$ volts, 17 watts, S-11 bulb, C-2-V filament, single-contact bayonet candelabra base. Pin position 90 deg. to plane of filament L.C.L. $1\frac{1}{4}$ in. commercial tolerances on filament location. *R-12-b.

13. *Hoods.*

(a) A hood shall be provided for each electric light unit.

(b) Hoods for high signals shall be made of sheet steel, copper-bearing, shall be not less than 10 in. long, and shall extend more than half-way around the lens opening.

(c) Hoods for dwarf signals shall be made of sheet steel, copper-bearing, shall be not less than 5 in. long, and shall extend half-way around the lens opening.

(d) Hoods shall be designed to minimize the likelihood of snow or ice accumulating on the lens or cover glass.

14. *Lenses and roundels.*

(a) Lenses and roundels shall be made in accordance with Specification 69, Manual Part 136.

(b) Lenses for high signals shall be of the doublet type, outer lens clear, $8\frac{3}{8}$ in. diameter; inner lens colored as required, $5\frac{1}{2}$ in. diameter. The focal length of lens combination to be $\frac{1}{2}$ in.

(c) Lenses for dwarf signals shall be of the doublet type, outer lens clear, 4 in. diameter; inner lens colored as required, $2\frac{3}{4}$ in. diameter. The focal length of lens combination to be $\frac{1}{2}$ in.

15. *Range.*

(a) Range shall be the distance on a tangent at which, under bright sunlight conditions, with the sun at or near the zenith, the indications will be clear and distinct to a person with normal vision.

* Alternate requisites section.

15. *Range.*—Continued.

(b) Range shall be determined with signal equipped with lens units of horizontal angle of visual spread specified in section 16-b.

(c) Range shall be as specified, with lamp burning at specified percentage of rated voltage.

(d) A satisfactory close-up signal indication shall be given.

16. *Spread.*

(a) The angle of spread is defined as the angle included by that portion of the beam within which the intensity of the beam is not less than 50 per cent of the candlepower of the axial beam.

(b) The angle of spread shall be as specified.

17. *Marker lights.*

(a) Marker lights conforming to Purchaser's drawing shall be provided as specified.

(b) Mounting for marker lights shall be as shown on Purchaser's drawing.

(c) Electric light units for marker lights shall be the same as for the main group.

18. *Mounting.*

(a) Mounting for main group and auxiliary electric light units shall be as shown on Purchaser's drawing.

19. *Wire and wiring.*

(a) Insulated wire shall be in accordance with Specification 111, Manual Part 186.

(b) Stranded insulated copper wire not less than No. 14 A.W.G. shall be used for wiring dwarf signals, and solid copper wire not less than No. 12 A.W.G. shall be used for wiring high signals.

(c) Wiring shall be neatly arranged and securely fastened.

(d) All wiring shall terminate at binding posts.

20. *Binding posts.*

(a) Binding posts, nuts and washers shall conform to Drawing 1070, assembly 107010, for field wire connections.

(b) Binding posts, nuts and washers conforming to Drawing 1070, assembly 10705, 107010, 107020, or soldered terminals, shall be used where no field wires are connected thereto.

(c) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

(d) Binding posts shall be spaced not less than 1 in. centers.

21. *Insulation.*

(a) Material used for insulation shall be such as will not be injuriously affected by atmospheric conditions.

22. Dielectric requirements.

(a) Electrical apparatus assembled shall withstand for one minute an insulation test, at place of manufacture, of 3,000 volts a.c. between all parts of electric circuits and other metallic parts insulated therefrom, except the lamp receptacle which shall withstand for one minute an insulation test of 800 volts a.c.

(b) With the exception of the lamp receptacle, a surface leakage distance of not less than $\frac{1}{4}$ in. shall be provided between any exposed metallic part of the apparatus carrying current and any other metallic part thereof.

23. Paint and painting.

(a) Paint and painting shall be in accordance with Specification 120, Manual Part 110.

(b) A finish coat of non-reflecting black, in accordance with Specification 214, Manual Part 221, shall be applied to all exposed metallic front parts of electric light units.

(c) A finish coat of non-reflecting black, in accordance with Specification 214, Manual Part 221, shall be applied to the inside of electric light units, and lamp compartments of dwarf signals.

(d) Hoods and backgrounds shall be painted with a first coat of red lead primer, or equivalent, and with a finish coat of non-reflecting black, in accordance with Specification 120, Manual Part 110.

24. Inspection.

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

25. Tests.

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Contractor shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

25. *Tests.*—Continued.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

26. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

27. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

28. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within one year after shipment to the Purchaser. This warranty shall not apply to any apparatus which shall have been repaired or altered in any way by anyone other than the Manufacturer thereof, so as to affect, in the Contractor's judgment, its proper functioning or reliability, or which has been subjected to misuse, negligence or accident.

Alternate requisites.

R-8-c.

Background shall be made of _____, with necessary reinforcements around all openings and outer edge and ribbed as necessary to afford sufficient strength to support the complete number of electric light units rigidly.

R-9-a.

Electric light unit cases shall be made of _____, weatherproof, and shall be equipped with suitable doors or covers. The doors or covers, when opened, shall provide easy access to all parts.

R-10-a.

Main group of electric light units shall be provided with a weatherproof _____ terminal box which shall conform to Purchaser's drawing.

Alternate requisites.—Continued.

R-12-b.

Rating of electric lamps shall be as follows:.....

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Specification 162-43—Color Position Light Signal,
Manual Part 50.(Revision of A.A.R. Signal Section Specification 157-45)
A.A.R. SIGNAL SECTION SPECIFICATION 157-50.

COLOR LIGHT SIGNAL, SEARCHLIGHT TYPE

*Proposed Revision*11. *Backgrounds and hoods.*

(d)—To be deleted.

18. *Paint and painting.*

(a) Paint and painting shall be in accordance with Specification 120, Manual Part 110.

(b) A finish coat of non-reflecting black, in accordance with Specification 214, Manual Part 221, shall be applied to all exposed metallic front parts of the signal case and to the metallic surfaces directly back of the inner lens.

(c) Hoods and backgrounds shall be painted with a first coat of red lead primer, or equivalent, and with a finish coat of non-reflecting black, in accordance with Specification 120, Manual Part 110.

19. *Binding posts.*

(a) Binding posts, nuts and washers shall conform to Drawing 1070, assembly 107010, for field wire connections.

(b) Binding posts, nuts and washers conforming to Drawing 1070, assembly 10705, 107010, 107020, or soldered terminals, shall be used where no field wires are connected thereto.

(c) Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

19. *Binding posts.*—Continued.

- (d) Binding posts shall be spaced not less than 1 in. centers.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 18-a, 19-a and 19-b of Specification 157-45—Color Light Signal, Searchlight Type, Manual Part 93.

COOPERATIVE REPORT

DEVELOPMENT OF PROPOSED INDUCTIVE COORDINATION
MEASURES INVOLVING RAILROAD POWER LINES AND
POWER EQUIPMENT, AS A RESULT OF THE ADOPTION
OF THE PRINCIPLES AND PRACTICES FOR THE
INDUCTIVE COORDINATION OF RAILWAY
ELECTRIC SUPPLY FACILITIES AND
THE COMMUNICATION FACILITIES
OF THE BELL SYSTEM*

E. N. Fox, Representative

L. B. Yarbrough, Alternate

Committee No. 7—Inductive Coordination, of the Communications Section, A.A.R., under their assignment, "Discussion of Fundamental Factors Involved in Inductive Coordination and of Remedial Measures Applicable Under Various Conditions," reached the conclusion at a meeting held on December 7, 1949 that while a considerable number of reports had been made on the theory of inductive interference an insufficient amount of practical information had been furnished.

It is felt that it would be of extreme value to the railroads to have a "rule of thumb" for action to be taken under different conditions which would in general advise what to expect from a particular proposed exposure and indicate whether or not further consideration need be given it.

It was brought out that reports along these lines had been prepared by engineers of The American Telephone and Telegraph Co., The Western Union Telegraph Co. and The Commonwealth & Southern Corporation. Copies of these, which are quite voluminous, have been obtained by the Committee, and they are preparing a report as to what should be done in particular situations.

The Committee also hopes to include some information on the effects of various systems of transposing. Complete installation specifications covering transpositions are available but information is lacking as to what can be expected from various types of exposures on the different systems.

* Previous report appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, p. 534.

Consideration is also to be given to the report, "Transposition Requirements in Erection of Signal Power Lines (Joint Signal—Communication Line Construction)," presented by Signal Section Committee IV at the 1949 Annual Meeting. (See p. 234, Vol. XLVI, A.A.R. Signal Section 1948 Proceedings.)

Communications Section Committee No. 7 has recently received a new assignment reading, "Investigate and report relative to interference between alternating current, signal supply circuits and communication circuits and submit recommendations as to transposition of the former that may be required."

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION LIGHTNING ARRESTERS—PROJECT C62

E. N. Fox, Representative

Mr. W. J. Rudge, Chairman, A.S.A. Sectional Committee C62, on December 28, 1949 advised all members of the Committee, in part, as follows:

"The working group of the Lightning Protective Devices Subcommittee of the A.I.E.E. Protective Devices Committee has completed a proposed revision of the Lightning Arrester Standard A.I.E.E. No. 28, A.S.A. C62.1, dated 1944. The revision has been submitted to me for consideration as a revision of A.S.A. C62.1.

"The N.E.M.A. Lightning Protective Devices Section also has revised their standard covering lightning arresters, and plan to submit it to the C62 Committee with the request that it be considered in any revision of the A.S.A. Standard.

"The existing C62.1 Standard covers only valve type lightning arresters, and since both the revision by A.I.E.E. and the N.E.M.A. Standard cover all types of lightning arresters except those used for communications and railway signal circuits, it appears that it will be necessary to set up a program in the C62 Committee to select and combine the material from these two sources into a suitable A.S.A. Standard."

Mr. Rudge has advised that no meeting of the Committee will be called until the N.E.M.A. Standard becomes available, which is expected to be ready in June 1950.

Action Recommended

Acceptance as information.

COMMITTEE V—CONTRACTS AND INSTRUCTIONS

Personnel

C. D. Cronk, Chairman	
E. B. Platt, Vice-Chairman	
B. F. Dickinson	H. J. Phillips
R. C. Dueland	J. A. Phillips
A. C. Eastman	E. L. Rogers
O. Falkenstein	G. C. Schindler
A. T. Hunot	W. L. Scott
F. M. Kunker	S. P. Searle
C. L. Ott	E. S. Taylor
G. R. Pflasterer	G. A. Washburn
F. Youngwerth	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Instructions for testing signal installations before placing in service.
4. Definitions for technical terms used in signaling.
5. Forms for reporting progress of the component parts of new signal installations and expenditures for labor.
6. Investigate and report on a simplified system of numbering and identification of wires and circuits which does not require the changing of nomenclature and tags on wayside circuits when a minor change is made.
7. Investigate and report on the use of portable induction type telephones by signal forces.
8. Specification covering an instrument for determining ground resistance.

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Definitions for Technical Terms Used in Signaling, Manual Part 55.

Revision of Instructions for Non-Coded Direct Current Track Circuits, Manual Part 8.

Revision of A.A.R. Sig. Sec. 1662C, 1673D, 1674E and 1680B.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee V at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

Definitions for Technical Terms Used in Signaling—Now in Manual Part 55.
Instructions for Direct Current Relays—Now in Manual Part 126.

Instructions for Time Releases Applied to Signal Apparatus—Now in Manual Part 128.

Instructions for Wire and Cable—Manual Part 190.

Instructions for Car Retarder Systems—Manual Part 125.

Instructions for Interlocking—Now in Manual Part 138.

Circuit Nomenclature and Written Circuits—Now in Manual Part 33.

A.A.R. Sig. Sec. 1664C—Graphical Symbols—Wayside Fixtures—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1673D (Three Sheets)—Graphical Symbols—Relays—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1674E (Three Sheets)—Graphical Symbols—Relay Contacts—Now in Drawing Section of Manual.

(Revision of Definitions for Technical Terms Used in Signaling)
A.A.R. SIGNAL SECTION DEFINITIONS.

TECHNICAL TERMS USED IN SIGNALING

1950

Alternator, Tuned. (New)

A direct current device, contacts of which operate to interrupt a direct current at a frequency predetermined by the mechanical tuning of its component parts, to produce alternating current.

Code Transmitter. (Revision)

A device to vary periodically an electrical circuit at a definite predetermined code frequency.

Coder. (Revision)

See definition for Code Transmitter.

Relay, Biased. (New)

A relay which will operate to its energized position by current of one polarity only, and will return to its de-energized position when current is removed.

Relay, Code Following. (New)

A relay which will follow or reproduce a code without distortion within practical limits.

Relay, Magnetic Stick. (New)

A relay the armature of which remains, at full stroke, in its last energized position when its control circuit is opened.

Relay, Overload. (New)

A relay which operates to open contacts when the current through its control coils exceeds a predetermined value.

Relay, Retained Neutral. (New)

A neutral relay, the armature of which is retained in the energized position for a predetermined interval of open circuit during the reversal of current in the control coils.

Relay, Retained Neutral Polarized. (Revision)

A polarized relay, the neutral armature of which is retained in the energized position for a predetermined interval of open circuit during the reversal of current in the control coils.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of Instructions for Non-Coded Direct Current Track Circuits)
A.A.R. SIGNAL SECTION INSTRUCTIONS.

NON-CODED DIRECT CURRENT TRACK CIRCUITS

1950

Adjustment.

1. Track circuits must be so adjusted that proper working current will flow through the coils of relay during minimum ballast resistance conditions, and checks made to determine that under these conditions, or maximum ballast resistance conditions, the current through the coils of track relay will not exceed 30 milliamperes for 2-ohm relays or 20 milliamperes for 4-ohm relays, having iron magnetic structure, and will not exceed 40 milliamperes for 2-ohm relays or 27 milliamperes for 4-ohm relays, having silicon steel magnetic structure, with train shunt applied as specified in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

2. When making train shunt resistance test it should be made in accordance with Form 7003, Manual Part 196.

Circuit controllers.

3. Switch circuit controllers must be maintained and tested in accordance with instructions for Switch Circuit Controllers, Manual Part 134.

Ballast, rail and bond resistance.

4. Ballast resistance should be kept as high as possible by keeping ballast free from rail and rail fastenings and providing proper drainage.

5. Bonding must be installed and maintained in condition to insure low resistance. Bolts in angle bars should be kept tight.

6. Direct current track circuit tests must be made in accordance with Forms 7021 and 7022, Manual Part 131.

7. Resistance of rails and bonding per 1,000 feet of track should not exceed the assigned value for the particular type of bonding employed.

8. Resistance of ballast should preferably be not less than 2 ohms per 1,000 feet of track.

Batteries.

9. Batteries must be maintained and tested in accordance with Instructions for Batteries and Cells, Manual Parts 14 and 7.

Bonding.

10. Bonding must be inspected as instructed and renewed as required.

11. Frogs must be so bonded that when removed, track circuit will be opened.

12. Shunt wires must be kept in place and in good condition.

13. Fouling circuits must be maintained in good condition.

Insulated rail joints.

14. Insulated rail joints must be maintained and tested in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

Rectifiers.

15. Rectifiers must be maintained and tested in accordance with Instructions for Rectifiers and Motor-Generators, Manual Part 68.

Relays.

16. Relays must be maintained and tested in accordance with Instructions for Direct Current Relays, Manual Part 126.

Shunting sensitivity.

17. Shunting sensitivity test of a track circuit must be made by determining the maximum resistance that can be placed across the rails opposite the relay and opposite the battery to cause the relay contacts to open. If this resistance is less than 0.06 ohm, corrective measures must be taken at once.

18. Shunting tests must be made as follows:

(a) Turnouts.

1. Switch point side of insulated joints in lead rails and at each end of fouling circuit.

(b) Crossovers.

1. Switch point side of insulated joints in lead rails and both sides of insulated joints at center of crossover.

2. Where center insulated joints are not used, make test as specified in Instruction 18-a.

19. Shunting tests must be made during dry weather conditions when the maximum current is flowing through the relay coils.

20. Top of rails should be kept free from sand, rust, and other foreign matter that affects proper shunting of track circuit.

21. For track circuits having 2-ohm or 4-ohm relays, resistance between battery and rails must be not less than that shown in Tables I, II, III and IV of Formulae for Computing Minimum Allowable Resistance Between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.

22. For track circuits having relays other than 2-ohm or 4-ohm resistance, minimum limiting resistance allowable in series with track battery must be determined, as instructed by proper authority.

General.

23. When track or other conditions are such that they may cause signal interruption or unsatisfactory operation of signal apparatus, the section foreman or whoever is immediately responsible for such conditions must be requested to remedy the condition. If such request is not acted upon within a reasonable time the matter must be reported to proper authority in writing.

24. Track circuit connectors and connections must be maintained in good condition.

25. Wire and cable must be maintained and handled in accordance with Instructions for Wire and Cable, Manual Part 190.

General.—Continued.

26. Lightning arresters must be properly connected and maintained.
27. Ground resistance test must be made in accordance with Instructions for Resistance of Made Grounds, Manual Part 61.
28. Pipe lines under rail must clear base of rail at least $\frac{1}{2}$ inch.
29. If a track circuit fails to operate properly, check for the following possible causes:
 - (a) Broken rail.
 - (b) Loose connections.
 - (c) Defects in bonding.
 - (d) Defects in insulated rail joints.
 - (e) Defects in switch rod, gage-plate or pipe-line insulation.
 - (f) Low resistance ballast.
30. Experiments or changes must not be made in track circuits except by permission of proper authority.
31. Any unusual occurrences or developments in track circuits must be promptly reported to proper authority.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Instructions for Non-Coded Direct Current Track Circuits,
Manual Part 8.

A.A.R. SIG. SEC. 1662D.

GRAPHICAL SYMBOLS—TRACKS AND HIGHWAY CROSSINGS

A.A.R. SIG. SEC. 1673E.

GRAPHICAL SYMBOLS—RELAYS

A.A.R. SIG. SEC. 1674F (Three Sheets).

GRAPHICAL SYMBOLS—RELAY CONTACTS

A.A.R. SIG. SEC. 1680C (Two Sheets).

GRAPHICAL SYMBOLS—CIRCUIT APPURTENANCES

The Committee submits revision of A.A.R. Sig. Sec. 1662C, 1673D, 1674E and 1680B.

As the graphical symbols for relays were becoming rather complicated and had reached a saturation point, the Committee has carefully reviewed and simplified them as much as possible. The number of symbols have been reduced and A.A.R. Sig. Sec. 1673E, one sheet, (formerly A.A.R. Sig. Sec. 1673D, three sheets) now shows basic relay characteristics which may be combined as required.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

A.A.R. Sig. Sec. 1662C—Graphical Symbols—Tracks and Highway Crossings (One Sheet).

A.A.R. Sig. Sec. 1673D—Graphical Symbols—Relays (Three Sheets).

A.A.R. Sig. Sec. 1674E—Graphical Symbols—Relay Contacts (Three Sheets).

A.A.R. Sig. Sec. 1680B—Graphical Symbols—Circuit Appurtenances (One Sheet).

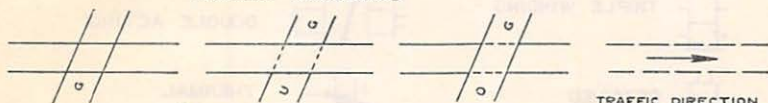
RAILROAD TRACKS

SIGNIFY STEAM OR ELECTRIC WHERE ELECTRIC TRACKS
CROSS OR JOIN STEAM TRACKS

	RED	YELLOW	YELLOW	
RAILROAD TRACK TO REMAIN	TRACK TO BE TAKEN UP	PROPOSED TRACKS	PROPOSED (FUTURE) TRACKS	FOREIGN TRACKS (TO BE INDICATED BY NAME)

NOTE: WHERE OTHER COLORS ARE USED, EXPLANATION OF
COLOR IS TO BE SHOWN ON PLAN.

HIGHWAY CROSSINGS



GRADE CROSSING

UNDERGRADE
CROSSINGOVERGRADE
CROSSINGNOTE: EXPLAIN AS FOLLOWS: STREET NAME, HIGHWAY NAME
AND NUMBER, FARM AND PRIVATE CROSSINGS, ANY
OTHER IDENTIFICATIONS.

HIGHWAY CROSSING SIGNALS



CROSSING SIGN



BELL



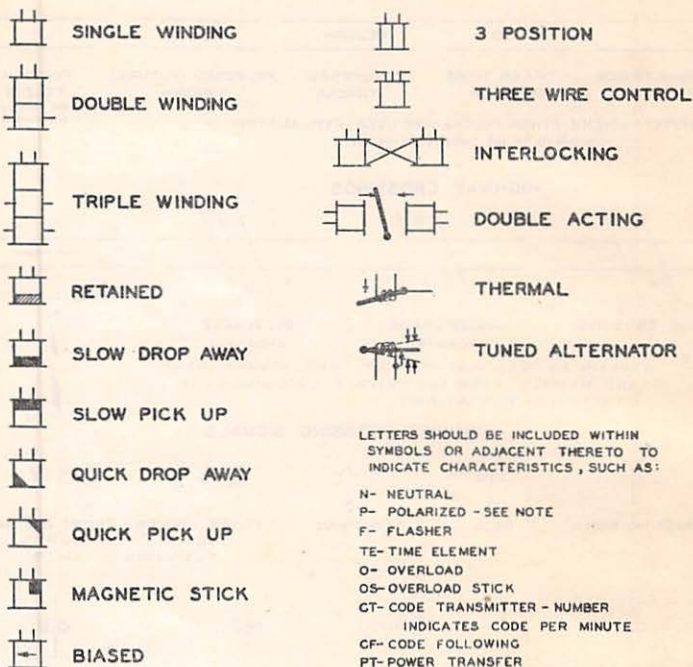
WIG-WAG

FRONT LIGHTS
ONLY
FLASHINGFRONT AND BACK
LIGHTSNUMBER OF TRACKS SIGN
MOUNTED ON SIGNAL MAST
NUMBER OF TRACKS TO BE
SHOWN ON PLAN OR COVERED
BY NOTE (SEE 1631)

NO TURN SIGNAL

FY: FLASHING YELLOW
NLT: NO LEFT TURN
NRT: NO RIGHT TURNSTOP ON RED
SIGNAL SIGNSTOP WHEN SWINGING
SIGNCROSSING GATE WITH
SIDEWALK ARMCROSSING GATE WITHOUT
SIDEWALK ARMGATE ARM
SIDEWALKGATE ARM
WITH LAMPSNOTE: HIGHWAY CROSSING SIGNAL SYMBOLS INDICATE BASIC
CHARACTERISTICS AND MAY BE COMBINED TO
FORM ADDITIONAL SYMBOLS. THESE BASIC SYMBOLS MAY
ALSO BE USED IN CONJUNCTION WITH OTHER GRAPHICAL
SYMBOLS AS REQUIRED. LETTERS SHOULD BE INCLUDED
WITHIN SYMBOLS OR ADJACENT THERETO TO INDICATE
CHARACTERISTICS, SUCH AS: A-AUTOMATIC, M-MANUAL,
A-M-AUTO-MANUAL.ROTATING
DISC.ILLUMINATED
STOP SIGNGRAPHICAL SYMBOLS
TRACKS AND HIGHWAY CROSSINGSAAR
SIG. SEC.
1662D

SEPT. 1950 | M-1947 | SEPT. 1947 | M-1944 | OCT. 1944 | M-1934 | MAR. 1934



LETTERS SHOULD BE INCLUDED WITHIN SYMBOLS OR ADJACENT THERETO TO INDICATE CHARACTERISTICS, SUCH AS:

N- NEUTRAL
P- POLARIZED - SEE NOTE
F- FLASHER
TE- TIME ELEMENT
O- OVERLOAD
OS- OVERLOAD STICK
CT- CODE TRANSMITTER - NUMBER
INDICATES CODE PER MINUTE
CF- CODE FOLLOWING
PT- POWER TRANSFER

NOTE:

SYMBOLS INDICATE BASIC RELAY CHARACTERISTICS AND MAY BE COMBINED AS REQUIRED. THESE BASIC SYMBOLS MAY ALSO BE USED IN CONJUNCTION WITH SYMBOLS FOR CIRCUIT APPURTENANCES AS REQUIRED.

SYMBOLS AS SHOWN ARE FOR RELAYS DESIGNED FOR VITAL CIRCUITS.

SYMBOLS FOR RELAYS DESIGNED FOR NON-VITAL CIRCUITS TO BE COVERED BY NOTE ON PLAN OR SHOWN THUS:

INFORMATION NOT COVERED BY SYMBOLS TO BE NOTED ON PLAN. ON BIASED RELAYS ARROW INDICATES DIRECTION OF CURRENT FLOW TO ENERGIZE RELAY.

SYMBOL FOR POLARIZED RELAY MAY BE USED FOR POLAR RELAY WHEN EXPLAINED BY NOTE.

OPTIONAL CONNECTIONS, THUS: MAY BE USED. SYMBOLS AS SHOWN MAY BE MODIFIED THUS: TO DESIGNATE DETACHABLE TYPE RELAYS.

SYMBOLS MAY BE MODIFIED THUS: FOR ALTERNATING CURRENT RELAYS.

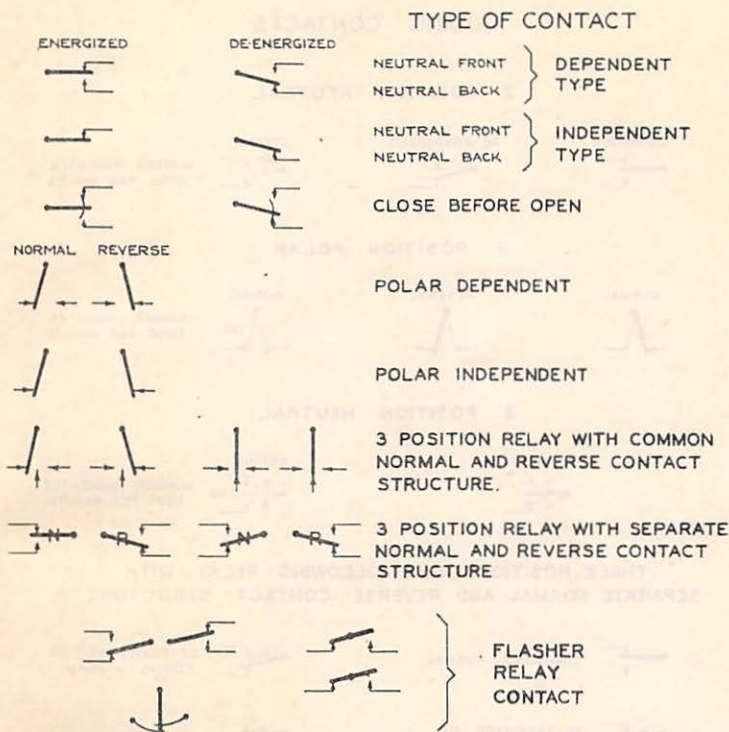
ADDITIONAL CONTROL WIRES TO BE SHOWN AS REQUIRED.

GRAPHICAL SYMBOLS RELAYS

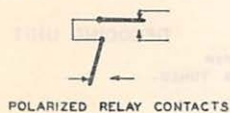
AAR
SIG. SEC.

SEPT-1950 M-1949 SEPT-1949 M-1946 SEPT-1946 M-1943 OCT-1943 M-1934 MAR-1934

1673E



NOTE: SYMBOLS MAY BE COMBINED TO FORM ADDITIONAL SYMBOLS, THUS:



GRAPHICAL SYMBOLS RELAY CONTACTS

AAR
SIG. SEC.
1674F

SEPT-1950 | M-1949 | SEPT-1949 | M-1948 | SEPT-1948 | M-1946 | OCT-1946 | M-1943 | OCT-1943 | M-1934 | MAR-1934

CODING CONTACTS

2 POSITION NEUTRAL



ENERGIZED



DE-ENERGIZED



CODING

NUMBER INDICATES
CODE PER MINUTE.

2 POSITION POLAR



NORMAL



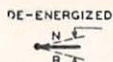
REVERSE



CODING

NUMBER INDICATES
CODE PER MINUTE

3 POSITION NEUTRAL



DE-ENERGIZED



CODING

NUMBER INDICATES
CODE PER MINUTETHREE POSITION CODE FOLLOWING RELAY WITH
SEPARATE NORMAL AND REVERSE CONTACT STRUCTURE

ENERGIZED NORMAL

DE-ENERGIZED OR
CODING NORMALDE-ENERGIZED OR
CODING REVERSE

ENERGIZED REVERSE



CODING NORMAL



CODING REVERSE

180 DU

DECODING UNIT

NUMBER INDICATES CODE PER
MINUTE TO WHICH UNIT IS TUNED.GRAPHICAL SYMBOLS
RELAY CONTACTSAAR
SIG. SEC.
1674F

SEPT-1950 | M-1949 | SEPT-1949 | M-1948 | SEPT-1948 | M-1945 | OCT-1946 | M-1943 | OCT-1945 | M-1954 | MAR-1954

RELAY CONTACTS WITH SPECIAL CHARACTERISTICS


 HIGH CURRENT


 HIGH VOLTAGE


 MAGNETIC
BLOWOUT


 CHECKING CONTACT
FOR TIME ELEMENT RELAY.


 FRONT } CONTACT ON
INTERLOCKING
RELAY WHICH
REMAINS CLOSED
WITH ARMATURE
IN INTERMEDIATE
POSITION.

 BACK

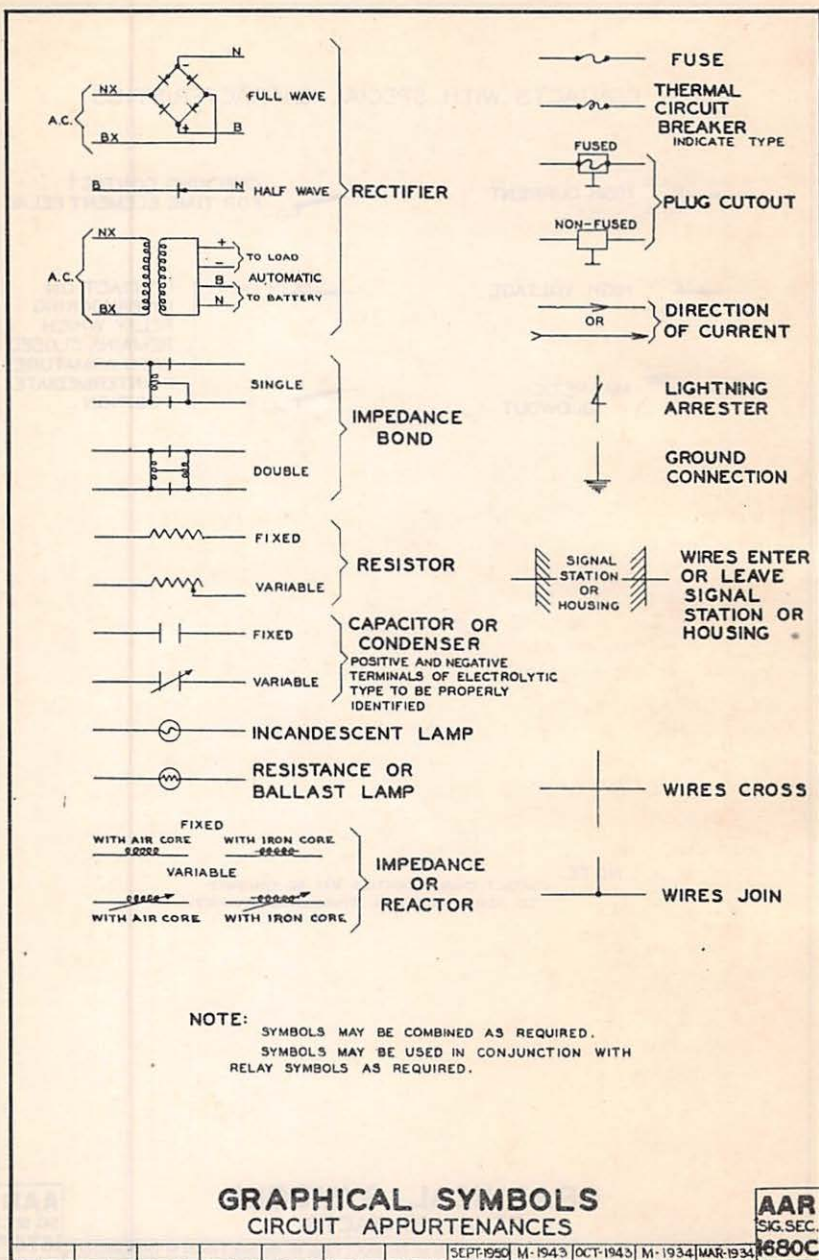
NOTE:

CONTACT CHARACTERISTICS MAY BE COMBINED
TO FORM ADDITIONAL SYMBOLS AS REQUIRED.

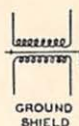
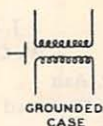
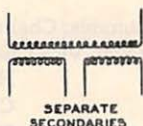
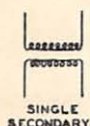
GRAPHICAL SYMBOLS RELAY CONTACTS

AAR
SG SEC.
1674F

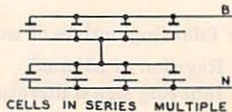
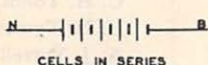
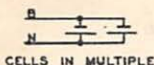
SEPT 1950 | M-1949 | SEPT 1949 | M-1948 | SEPT 1948 | M-1946 | OCT 1946 | M-1945 | OCT 1945 | M-1934 | MAR 1934



TRANSFORMER



BATTERY



SPECIFY NUMBER, TYPE AND
CAPACITY OF CELLS.
SL - STORAGE - LEAD
SA - STORAGE - ALKALINE
D - DRY
P - PRIMARY

EXAMPLE - 5 SL 80AH

GRAPHICAL SYMBOLS

CIRCUIT APPURTENANCES

AAR
SIG. SEC.
1680C

SEPT-1950 | M-1943 | OCT-1943 | M-1934 | MAR-1934

COMMITTEE VI—DESIGNS

Personnel

J. C. Lummis, Chairman
W. G. Brown, Vice-Chairman

P. P. Ash	H. M. Sova
R. I. Becksted	C. J. R. Taylor
E. F. Brown	D. B. Thomas
W. A. Ford	C. C. Thorn
A. S. Haigh	T. W. Tizzard
W. T. Lewis	C. H. Tobin
H. P. Schmidt	C. N. Tymeson
P. E. Snead	A. J. Yarrell

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Designs.
4. Specifications and drawings covering reflector lenses and similar devices for signals and signs, collaborating with Committee VIII.
5. Simplification of sizes and kinds of electric lamps for signal purposes, cooperating with Purchases and Stores Division, A.A.R.
6. Specification for concrete, reinforcement and test requirements for precast concrete foundations, monolithic and sectional types.
7. Design a universal switch adjustment bracket.
8. Design a universal adjustment bracket for application of lock rod to front rod.
9. Investigate and report on means and methods for the improvement of incandescent electric lamps used in signaling.
10. Investigate and report on performance and tentative design requirements as a possibility for future consideration of reflecting material as an alternate for reflector units on existing drawings which use reflector units on highway crossing signs used on railroad highway crossing signal assemblies. This to include consideration of reflecting backgrounds in lieu of reflecting legend.

The Committee submits for consideration, reports on the following subjects*:

1. Revised drawings.
Revision of Specification 190-49, Manual Part 166.
Revision of Specification 232-48, Manual Part 244.
Revision of Specification 231-47, Manual Part 237.
Revision of Specification for Bolts, Nuts and Threads, Manual Part 17.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Sept. 1950]

3. New drawings.

Cooperative report. American Standards Association—Standardization and Unification of Screw Threads—Project B1.

Cooperative report. American Standards Association—Plain and Lock Washers—Project B27.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.

A.I.S.I.—American Iron & Steel Institute, 350 Fifth Ave., New York 1, N. Y.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee VI at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

A.A.R. Sig. Sec. 1056F—Terminal Blocks—Short Type—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1077B—Terminal Block—Long Type—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1446C—Electric Light Unit for Semaphore Lighting—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1645D—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1656D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8-Inch Pipe—Assemblies—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1657D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8-Inch Pipe—Details—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1492A—Crossing Gate Sidewalk Arm—Now in Drawing Section of Manual.

A.A.R. Sig. Sec. 1700A—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Details and Assemblies—Now in Drawing Section of Manual.

R.S.A. 1175—Hydrometer (Stationary Lead Type Storage Battery)—Obsolete—Removed from Manual.

A.A.R. Sig. Sec. 1375B—Thermometer—Lead Type Storage Battery—Obsolete—Removed from Manual.

Drawing 1456—Torque Testing Apparatus—Obsolete—Removed from Manual.

A.R.A. Sig. Sec. 1624A—Tension Test Specimen—Obsolete—Removed from Manual.

Specification 174-49—Electric Light Unit for Semaphore Signal—Now in Manual Part 12.

Specification 236-49—Electric Light Unit for Highway Crossing Gate Arm—Now in Manual Part 263.

Specification 190-49—Electric Light Unit for Highway Crossing Signal—Reflector Type—Now in Manual Part 166.

Specification 156-49—Reflector Unit—Now in Manual Part 43.

Specification 51-49—Incandescent Electric Lamps—Now in Manual Part 91.

(Revision of A.A.R. Signal Section Specification 190-49)
A.A.R. SIGNAL SECTION SPECIFICATION 190-50.

**ELECTRIC LIGHT UNIT FOR HIGHWAY CROSSING SIGNAL
REFLECTOR TYPE**

Proposed Revision

6. Design.

(d) Case shall be designed for attachment to elbow of cross-arm assembly, Drawing 1468 or 1656, or to bracket of cross-arm assembly, Drawing 1463, as specified by the Purchaser. The door shall open in front and be hinged at the side or bottom.

(i) Case shall be so designed that the center of roundel and side lights shall be not less than $7\frac{1}{4}$ in. nor more than $9\frac{3}{4}$ in. below the center of the cross-arm, Drawings 1468 and 1656 for suspended light units, or not less than $1\frac{1}{2}$ in. nor more than 2 in. below the center of the cross-arm, Drawing 1463 for extended light unit.

(m) Case shall be designed with wire entrance at point of attachment to elbow of cross-arm assembly, Drawing 1468 or 1656, or to bracket of cross-arm assembly, Drawing 1463.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 6-d, 6-i and 6-m of Specification 190-49—Electric Light Unit for Highway Crossing Signal—Reflector Type,
Manual Part 166.

(Revision of A.A.R. Signal Section Specification 232-48)
A.A.R. SIGNAL SECTION SPECIFICATION 232-50.

ELECTRIC LIGHT UNIT FOR HIGHWAY CROSSING SIGNAL DOUBLET LENS TYPE

Proposed Revision

6. *Design.*

(e) Case shall be designed for attachment to elbow of cross-arm assembly, Drawing 1468 or 1656, or to bracket of cross-arm assembly, Drawing 1463, as specified by the Purchaser. Suitable door or doors shall be on the side or sides of the case.

(h) Case shall be so designed that the center of the lenses and side lights shall be not less than $7\frac{1}{4}$ in. nor more than $9\frac{3}{4}$ in. below the center of the cross-arm, Drawings 1468 and 1656, for suspended light units, or not less than $1\frac{1}{2}$ in. nor more than 2 in. below the center of the cross-arm, Drawing 1463, for extended light units.

(k) Door or doors shall provide:

2. A locking lug with a minimum opening of $\frac{1}{2}$ in. for application of a lock. *R-6-k-2.

(l) Case shall be designed with wire entrance at point of attachment to elbow of cross-arm assembly, Drawing 1468 or 1656, or to bracket of cross-arm assembly, Drawing 1463.

(m) Machine screws, washers, bolts, nuts and hinge pins shall be of corrosion-resisting metal or suitably plated after threads have been cut. Zinc or cadmium shall not be used on parts carrying current.

(n) A breather opening with suitable filter shall be provided at bottom of case.

(o) Means shall be provided in the design for accurate alignment of the projected light beam to a predetermined point on the highway.

Alternate requisites.

R-6-k-2.

Locking lug shall not be provided.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 6-e, 6-h, 6-k-2, 6-l, 6-m and 6-n of Specification 232-48—
Electric Light Unit for Highway Crossing Signal—Doublet Lens Type,
Manual Part 244.

(Revision of A.A.R. Signal Section Specification 231-47)
A.A.R. SIGNAL SECTION SPECIFICATION 231-50.

"NO RIGHT TURN"—"NO LEFT TURN" ILLUMINATED SIGN

Proposed Revision

1. Purpose.

(a) This specification is for the purpose of providing an electrically operated sign to display the legend "No Right Turn" or "No Left Turn," for use in signal assembly, Drawing 1488. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. Drawings.

- (c) Drawings forming an essential part hereof are as follows:
1. Electric Light Unit—Illuminated Highway Crossing Sign—Drawing 1481.
 2. Illuminated Highway Crossing Sign—Front of Mast Mounting for 4 to 8-Inch Pipe—Drawing 1482.
 3. Illuminated Highway Crossing Sign—Side of Mast Mounting for 4 to 8-Inch Pipe—Drawing 1483.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 1-a of Specification 231-47—"No Right Turn"—"No Left Turn" Illuminated Sign, Manual Part 237.

(Revision of Specification for Bolts, Nuts and Threads)

SPECIFICATIONS FOR BOLTS, NUTS AND THREADS

1950

The recommended specifications for bolts, nuts and threads are current American Standards B18.2 (Wrench-Head Bolts and Nuts and Wrench Openings) and B1.1 (Unified and American Screw Threads), issued by the American Standards Association.

Unless otherwise specified in A.A.R. Signal Section drawings and specifications:

- (a) Bolts and nuts shall be of steel, hot-rolled or cold-finished, in accordance with A.I.S.I. Specifications C-1020 or C-1120.
- (b) Bolt heads shall be regular, unfinished and square.
- (c) Nuts shall be heavy, unfinished and hexagon.
- (d) All threads shall be:
 - 1. UNC-2A for external.
 - 2. UNC-2B for internal.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification for Bolts, Nuts and Threads,
Manual Part 17.

REVISED DRAWINGS

A.A.R. Sig. Sec. 1642E—Railroad Crossing Sign—90 Deg. Reflector Type for 4 to 8-Inch Pipe—Assembly.

A.A.R. Sig. Sec. 1643E—Front Plates for Railroad Crossing Sign—90 Deg. Reflector Type—Details.

Titles and details changed in accordance with latest practice and arranged together with new drawing, A.A.R. Sig. Sec. 1701A, so that front and back plates may be ordered separately.

A.A.R. Sig. Sec. 1646D—Stop on Red Signal Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly.

Title and details changed in accordance with latest practice and arranged together with new drawing, A.A.R. Sig. Sec. 1702A, so that front and back plates may be ordered separately.

A.A.R. Sig. Sec. 1648D—Stop When Swinging Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly.

Title and details changed in accordance with latest practice and arranged together with new drawing, A.A.R. Sig. Sec. 1703A, so that front and back plates may be ordered separately.

A.A.R. Sig. Sec. 1692C—Railroad Crossing Sign—50 Deg. Reflector Type for 4 to 8-Inch Pipe—Assembly.

A.A.R. Sig. Sec. 1693D—Front Plates for Railroad Crossing Sign—50 Deg. Reflector Type—Details.

Titles and details changed in accordance with latest practice and arranged together with new drawing, A.A.R. Sig. Sec. 1704A, so that front and back plates may be ordered separately.

A.A.R. Sig. Sec. 1489D—Highway Crossing Signal—Flashing Light Type With Suspended Lights and Mast Mounted Gate—Assembly.

Title and details changed and arranged together with new drawings, A.A.R. Sig. Sec. 1468A and 1469A to show assembly of flashing light signal parts to provide clearance for gate arms; also to show mechanism mounted on sidewalk side of mast.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

A.A.R. Sig. Sec. 1642D—90 Deg. Reflector Crossing Sign Assembly.

A.A.R. Sig. Sec. 1643D—90 Deg. Reflector Crossing Sign Details.

A.A.R. Sig. Sec. 1646C—Reflector Stop on Red Signal Sign.

A.A.R. Sig. Sec. 1648C—Reflector Stop When Swinging Sign.

A.A.R. Sig. Sec. 1692B—50 Deg. Reflector Crossing Sign Assembly.

A.A.R. Sig. Sec. 1693C—50 Deg. Reflector Crossing Sign Details.

A.A.R. Sig. Sec. 1489C—Automatic Crossing Gate and Signal Assembly.

NEW DRAWINGS

A.A.R. Sig. Sec. 1462A—Highway Crossing Signal—Flashing Light Type With Extended Lights and Pedestal Mounted Gate—Assembly.

A.A.R. Sig. Sec. 1463A—Cross-Arm for Extended Lights—For Flashing Light Highway Crossing Signal with Pedestal Mounted Gate—Assembly.

A.A.R. Sig. Sec. 1464A—Cross-Arm and Brackets for Extended Lights—For Flashing Light Highway Crossing Signal—Details.

A.A.R. Sig. Sec. 1465A—Extension Bracket—For Highway Crossing Signs.

A.A.R. Sig. Sec. 1493A—Highway Crossing Gate Roadway Arm—For Pedestal Mounting.

A.A.R. Sig. Sec. 1494A—Highway Crossing Gate Sidewalk Arm—For Pedestal Mounting.

Drawings prepared in connection with Signal Section requisites and specifications being revised to include pedestal mounted short-arm gates.

A.A.R. Sig. Sec. 1488A—"No Right Turn" or "No Left Turn" Signal—Assembly.

Drawing prepared in connection with revision of Requisites for "No Right Turn" and "No Left Turn" Signs for Highway Crossings at Grade Over Railroad Tracks, Manual Part 224.

A.A.R. Sig. Sec. 1701A—Back Plates for Railroad Crossing Sign—90 Deg. Reflector Type—Details.

A.A.R. Sig. Sec. 1702A—Front and Back Plates for Stop On Red Signal Sign—Reflector Type—Details.

A.A.R. Sig. Sec. 1703A—Front and Back Plates for Stop When Swinging Sign—Reflector Type—Details.

A.A.R. Sig. Sec. 1704A—Back Plates for Railroad Crossing Sign—50 Deg. Reflector Type—Details.

See explanation under revised drawings, A.A.R. Sig. Sec. 1642E, 1643E, 1646D, 1648D, 1692C and 1693D.

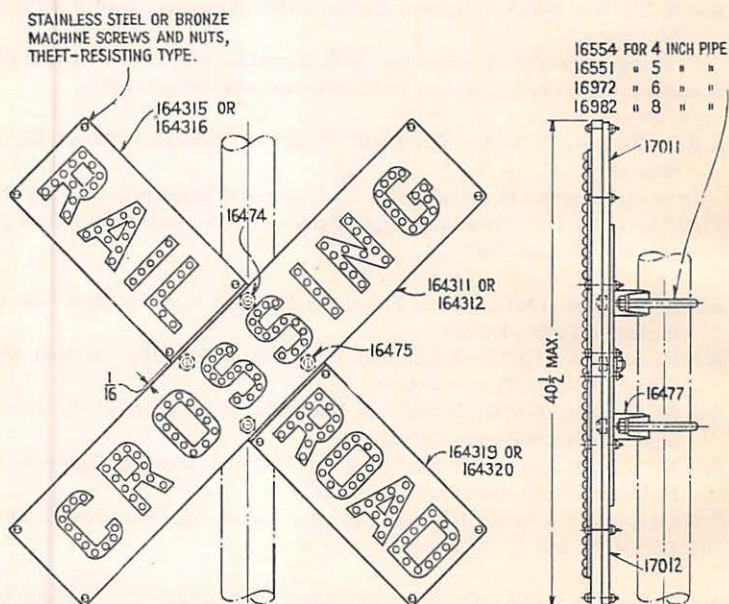
A.A.R. Sig. Sec. 1468A—Cross-Arm for Suspended Lights—For Flashing Light Highway Crossing Signal With Mast Mounted Gate—Assembly.

A.A.R. Sig. Sec. 1469A—Brackets for Suspended Lights—For Flashing Light Highway Crossing Signal—Details.

See explanation under revised drawing, A.A.R. Sig. Sec. 1489D.

Action Recommended

Acceptance for submission to letter ballot.



16428 RAILROAD CROSSING SIGN COMPLETE, SYNTHETIC ENAMEL FINISH FOR (SPECIFY PIPE SIZE)
16429 " " " " " VITREOUS " " * " " " "

* ON FRONT PLATES ONLY.

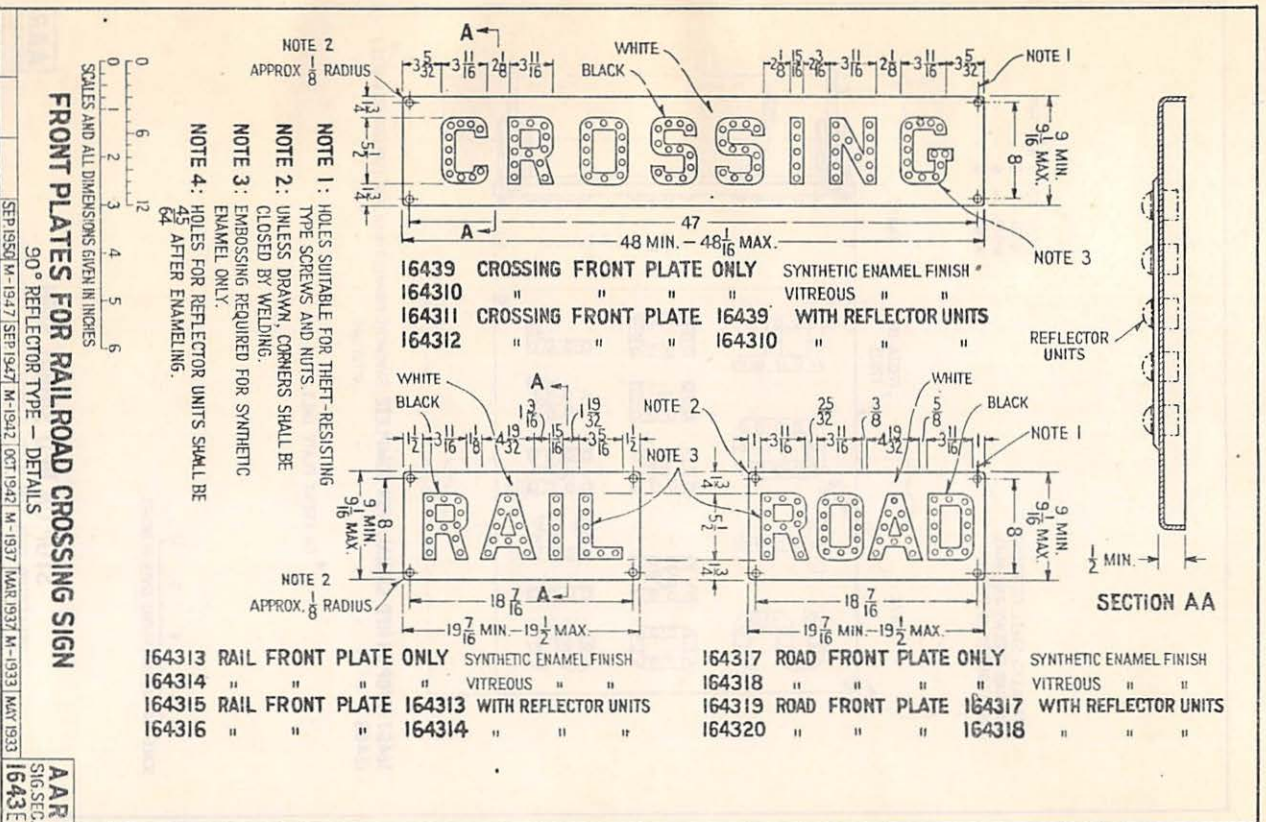
0 6 12 24
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

RAILROAD CROSSING SIGN

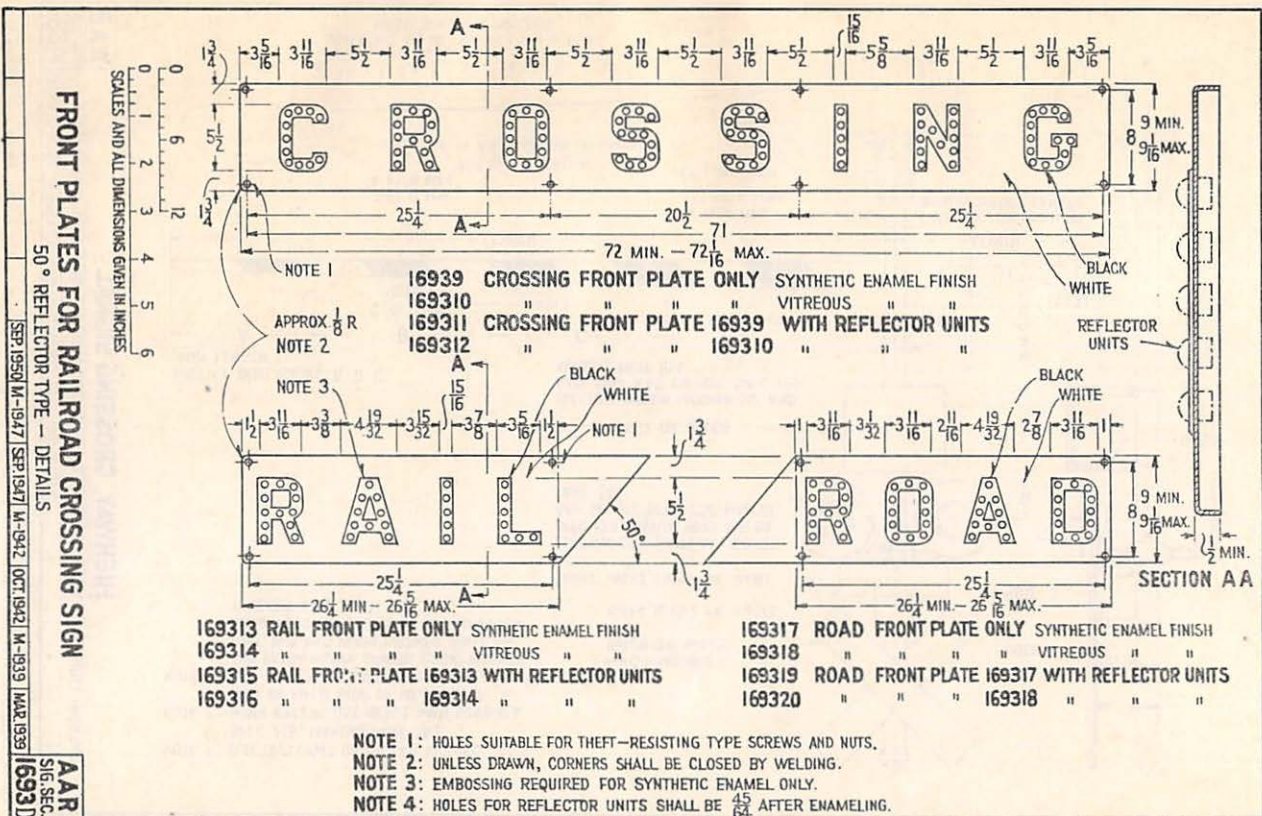
90° REFLECTOR TYPE FOR 4 TO 8 INCH PIPE — ASSEMBLY

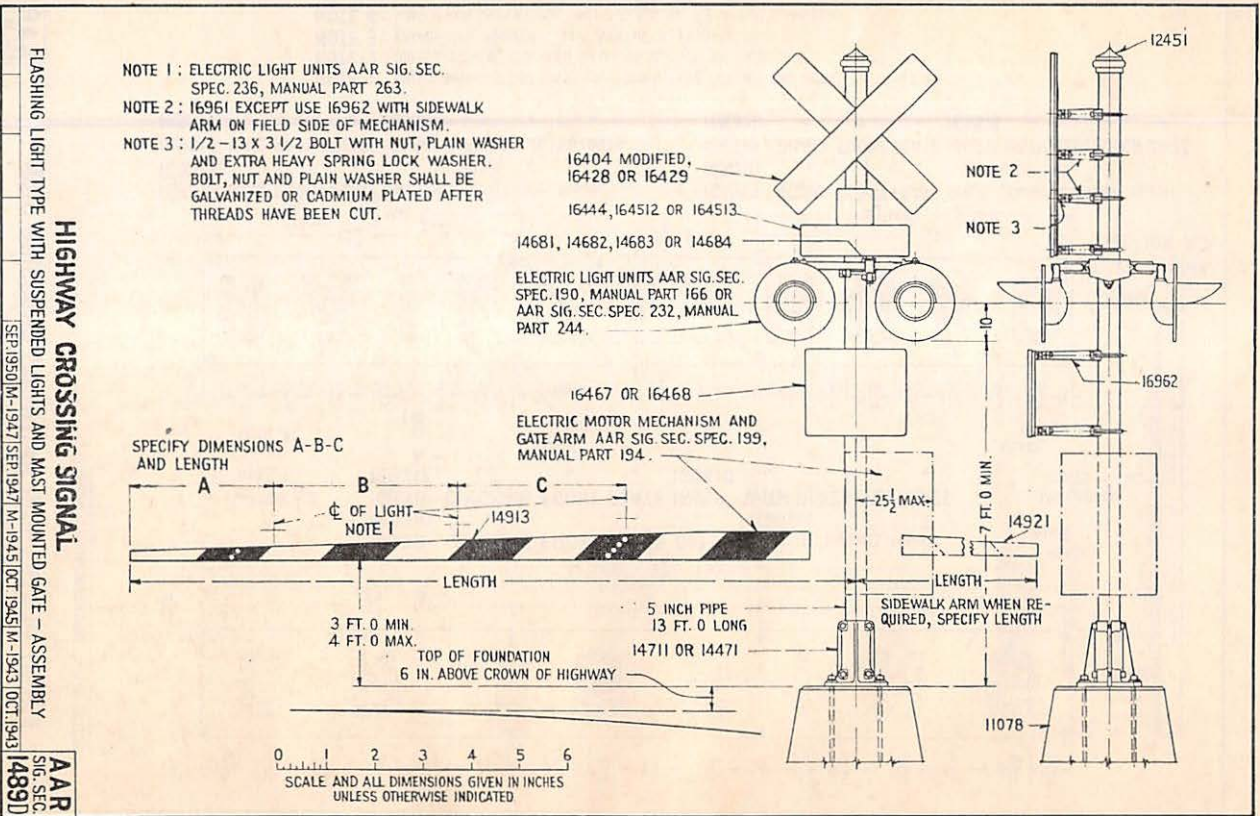
AAR
SIG. SEC.
1642E

SEP. 1950 | M-1947 | SEP. 1947 | M-1942 | OCT. 1942 | M-1937 | MAR. 1937 | M-1933 | MAY 1933



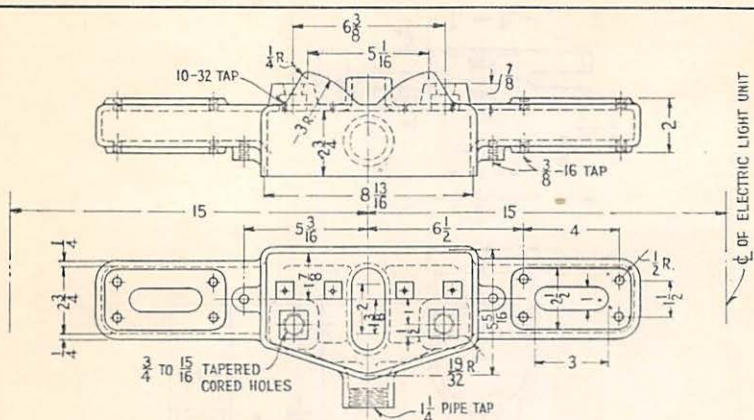




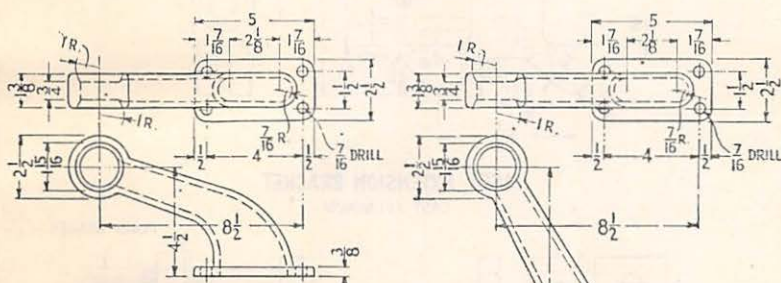


Bolts, nuts and threads shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17.

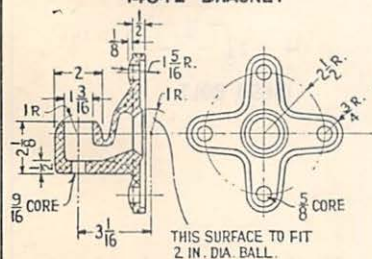
Spring lock washers shall be carbon steel (A.S.A. current Specification B27.1 is preferred where practicable).



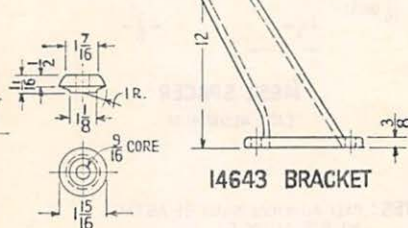
I4641 CROSS-ARM ONLY



I4642 BRACKET



I4644 BRACKET



I4643 BRACKET

I4645 WASHER

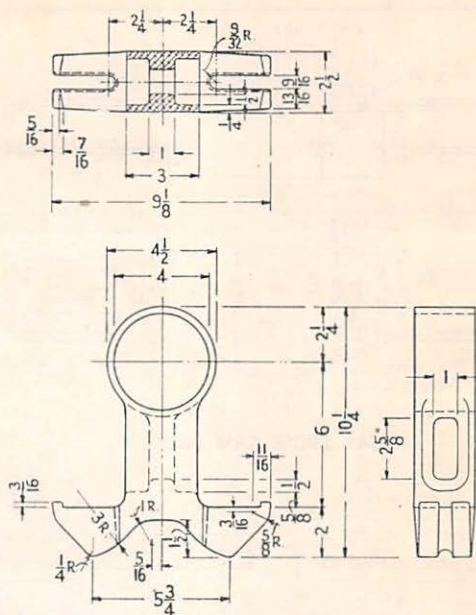
MATERIAL: CAST ALUMINUM A.S.T.M.
NO. B26 ALLOY G1.

0 1 2 3 6 9 12
SCALE AND ALL DIMENSIONS GIVEN IN INCHES

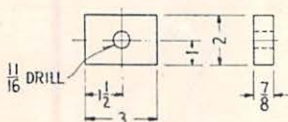
CROSS-ARM AND BRACKETS FOR EXTENDED LIGHTS
FOR FLASHING LIGHT HIGHWAY CROSSING SIGNAL — DETAILS

AAR
SIG. SEC.
I464 A

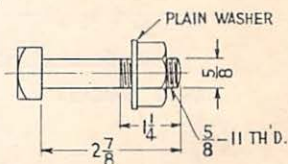
SEP. 1950



14651 EXTENSION BRACKET
CAST ALUMINUM

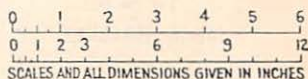


I4652 SPACER
CAST ALUMINUM



14653 BOLT

NOTES: CAST ALUMINUM SHALL BE ASTM.
NO. B26 ALLOY G1.
BOLTS, NUTS AND WASHERS SHALL BE
GALVANIZED OR CADMIUM PLATED.
GALVANIZING OR CADMIUM PLATING
SHALL BE DONE AFTER THREADS
HAVE BEEN CUT.

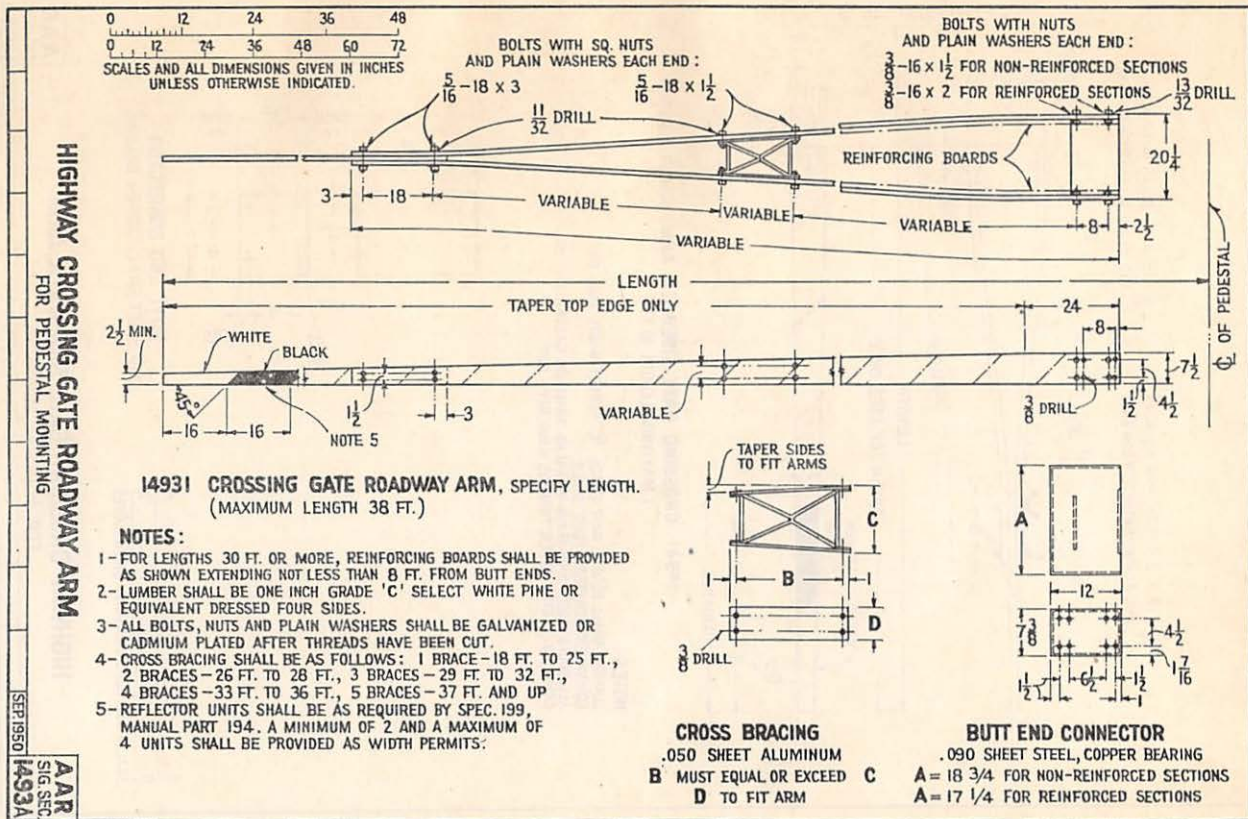


EXTENSION BRACKET FOR HIGHWAY CROSSING SIGNS

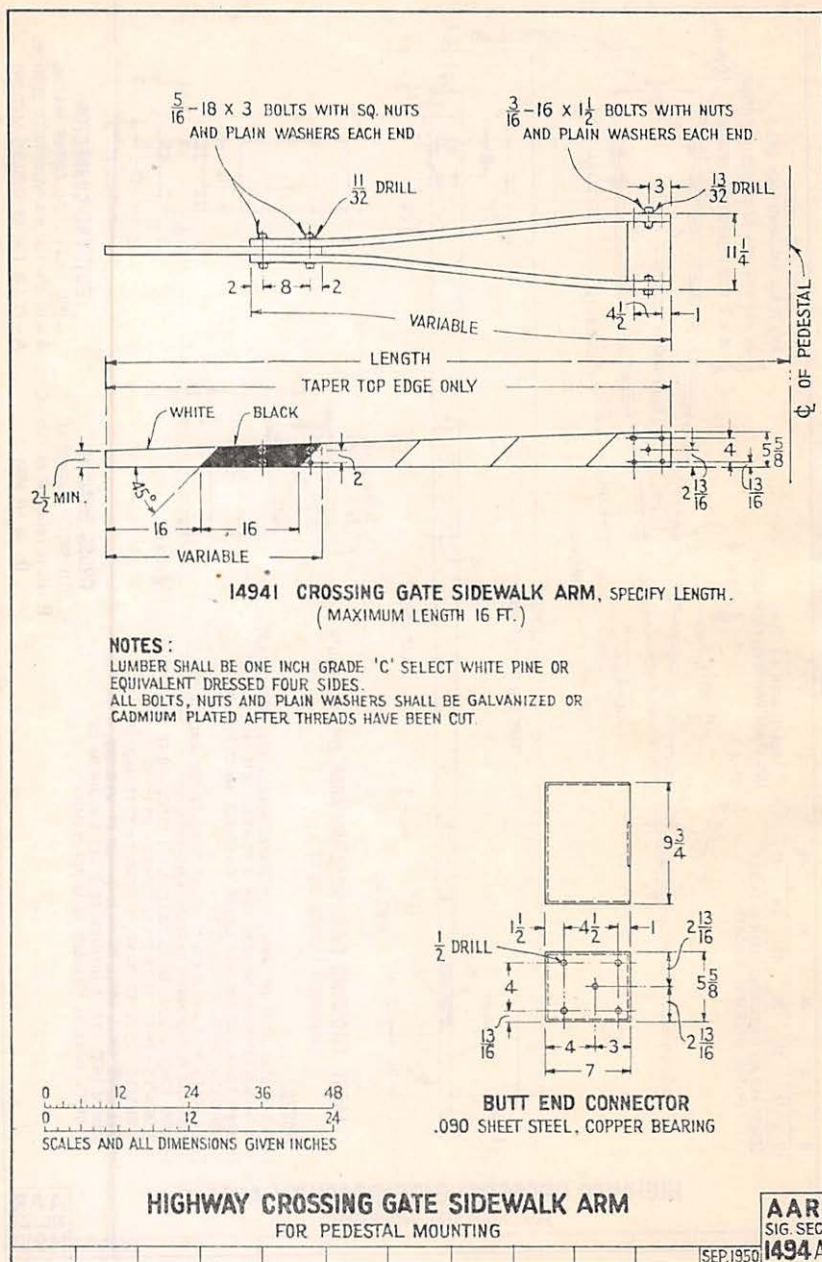
AAR
SIG.SEC
1465A

SEP 1950

Bolts, nuts and threads shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17.



Bolts, nuts and threads shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17; Aluminum shall be in accordance with Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220; Paint and painting shall be in accordance with Specification 120, Manual Part 110.

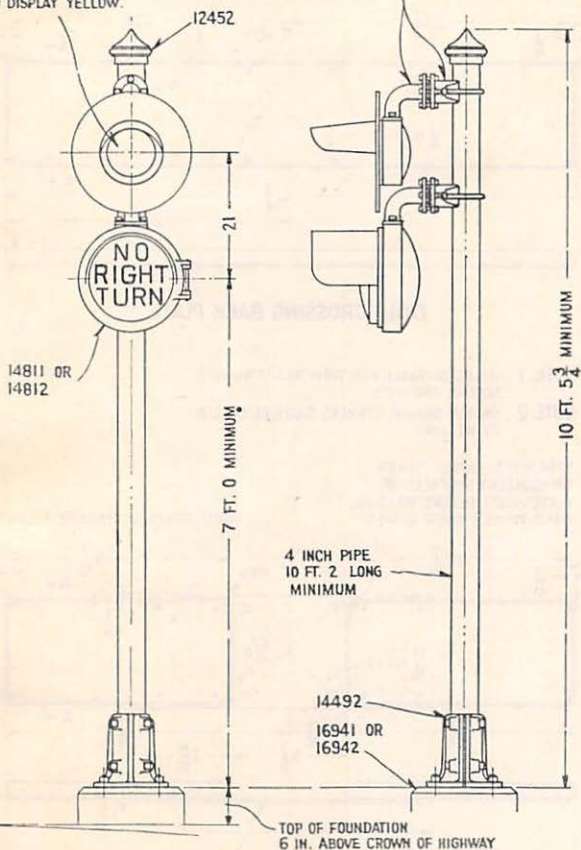


Bolts, nuts and threads shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17.

Paint and painting shall be in accordance with Specification 120, Manual Part 110.

ELECTRIC LIGHT UNIT:
AAR SIG. SEC. SPEC. 190, MANUAL PART 166 OR
AAR SIG. SEC. SPEC. 232, MANUAL PART 244,
EXCEPT TO DISPLAY YELLOW.

MOUNTING IN ACCORDANCE WITH:
1482 FOR FRONT OF MAST,
1483 FOR SIDE OF MAST.



NOTES:

- 1 — THIS DRAWING IS TYPICAL AND VARIATIONS IN THE MOUNTINGS ARE PERMISSIBLE.
- 2 — PIPE, BASE AND PINNACLE SHALL BE PAINTED WHITE OR ALUMINUM.

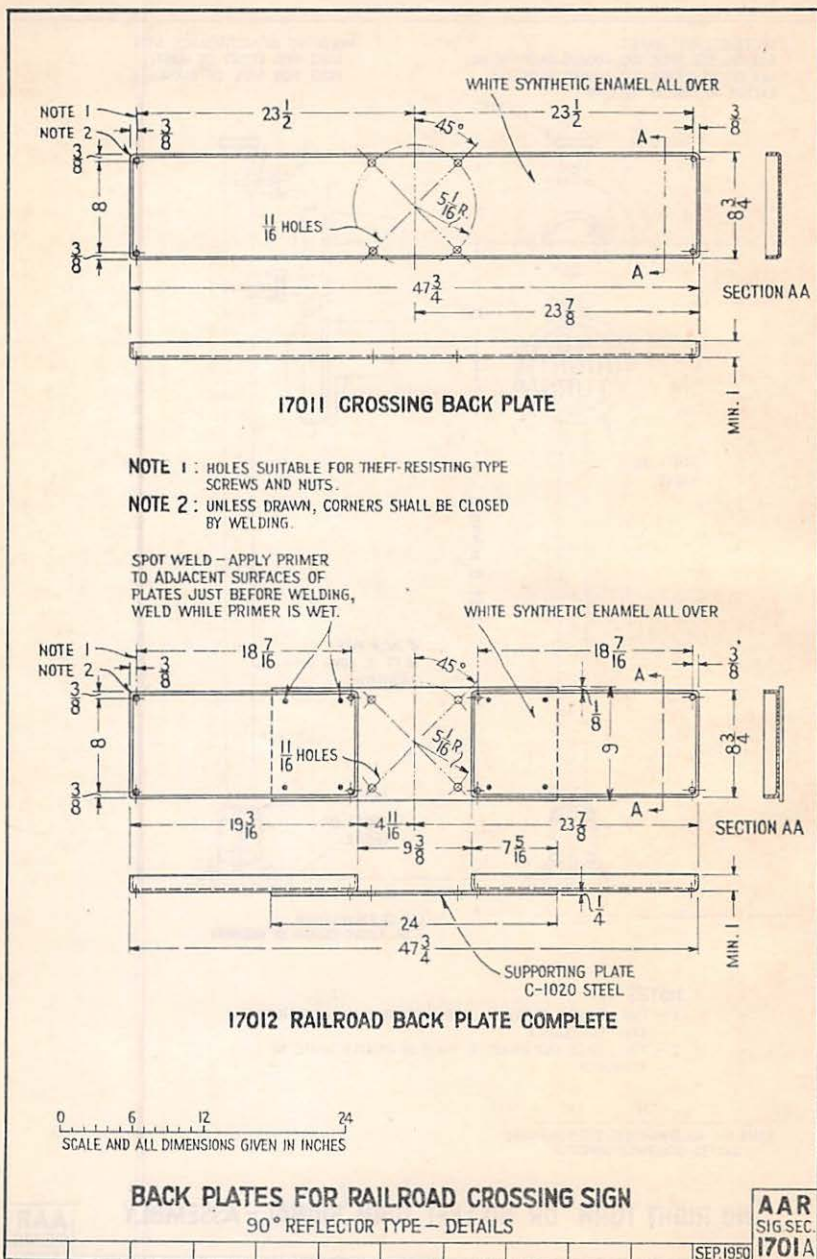
0 12 24 3 FT. 4 FT.

SCALE AND ALL DIMENSIONS GIVEN IN INCHES
UNLESS OTHERWISE INDICATED

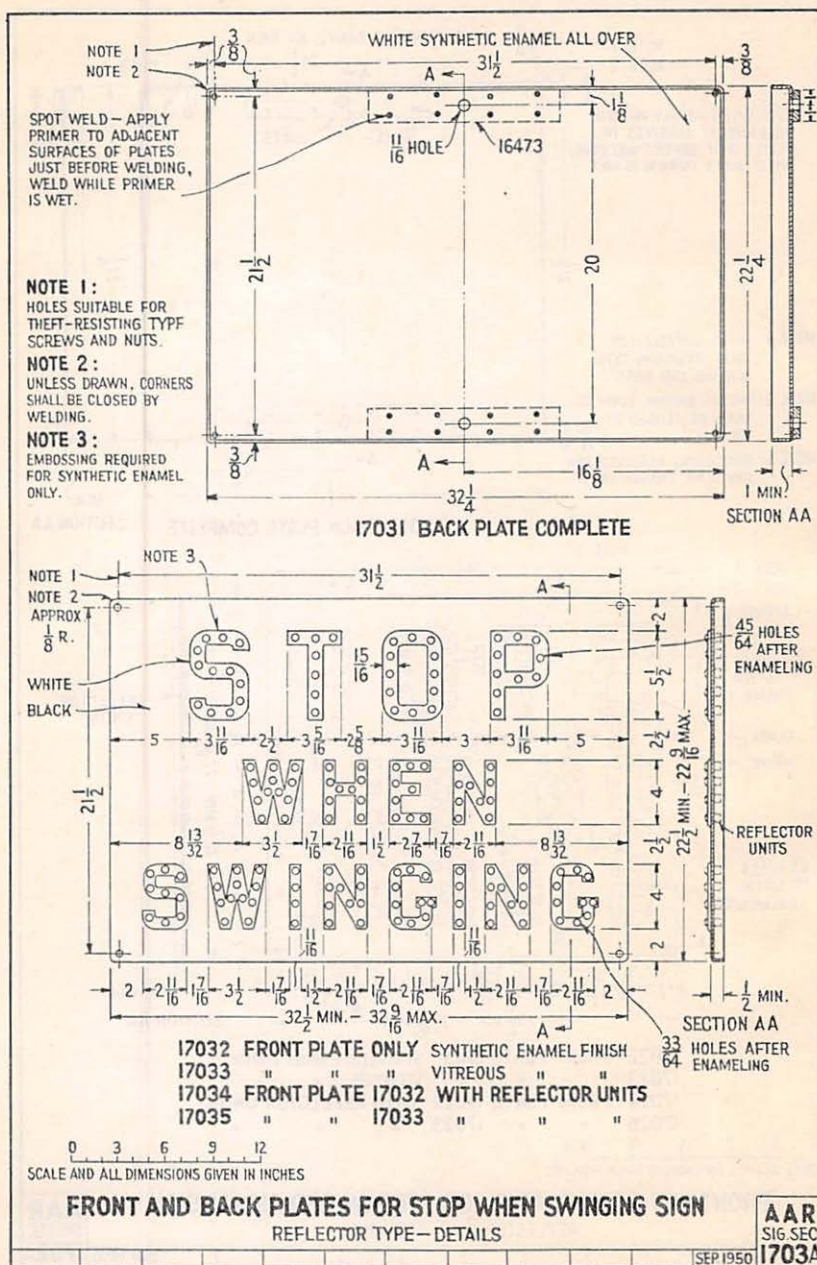
"NO RIGHT TURN" OR "NO LEFT TURN" SIGNAL — ASSEMBLY

AAR
SIG. SEC.
1488A

SEP 1950

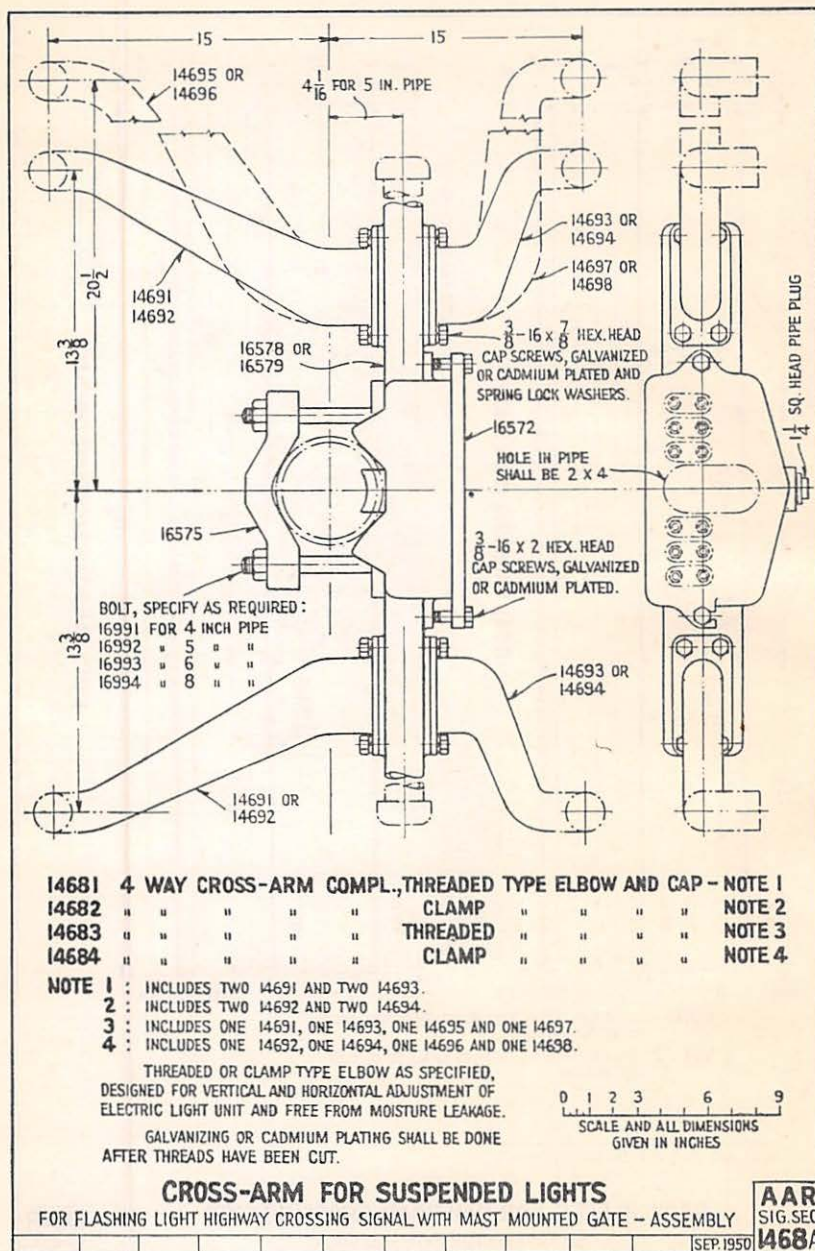


Material and painting shall be in accordance with Specification 155,
Manual Part 44.



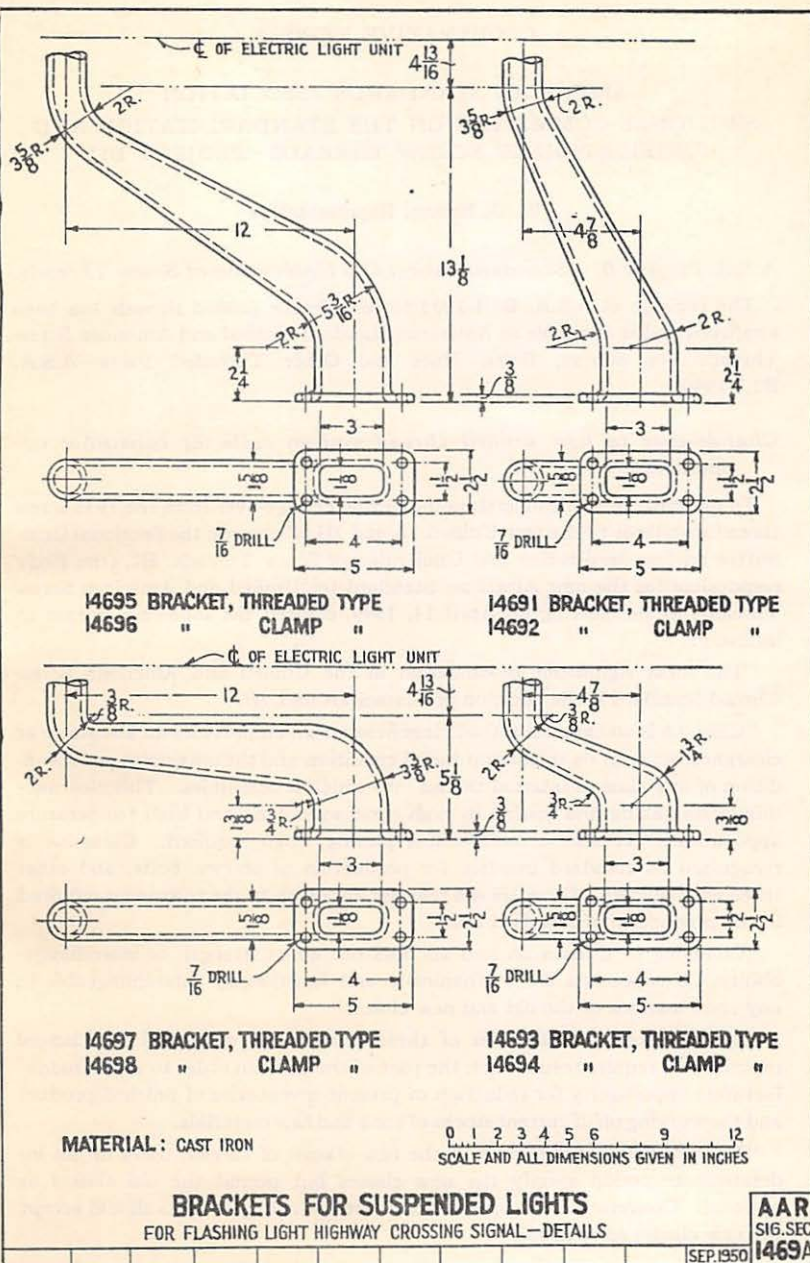
Material and painting shall be in accordance with Specifications 155 and 156,
Manual Parts 44 and 43.





Bolts, nuts and threads shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17.

Spring lock washers shall be carbon steel (A.S.A. current Specification B27.1 is preferred where practicable).



Cast iron shall be in accordance with Specification for Gray Iron Castings, Manual Part 88.
 Painting shall be in accordance with Specification 120, Manual Part 110.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION
SECTIONAL COMMITTEE ON THE STANDARDIZATION AND
UNIFICATION OF SCREW THREADS—PROJECT B1*

W. G. Brown, Representative

A.S.A. Project B1—Standardization and Unification of Screw Threads.

The revision of A.S.A. B1.1-1935 to include the unified threads has been approved and is available as American Standard Unified and American Screw Threads For Screws, Bolts, Nuts and Other Threaded Parts—A.S.A. B1.1-1949.

Change-over to new unified thread system calls for consumer co-operation.

To minimize any misunderstanding during change-over from the 1935 screw thread standards to the new Unified 2A and 2B tolerances, the Sectional Committee on Standardization and Unification of Screw Threads, B1, (the Body responsible for the new American Standard for Unified and American Screw Threads) at its meeting on April 14, 1949, drafted the following release to industry:

"The most significant modification in the Unified and American Screw Thread Standard is the addition of Classes 2A and 2B.

"Class 2A is an external thread classification which provides an allowance or clearance between its maximum metal condition and the maximum metal condition of any class of internal thread into which it assembles. This clearance minimizes galling and seizing in high-cycle wrenching and high temperature applications. It also accommodates plating when required. Class 2A is recognized as standard practice for production of screws, bolts, and other threaded fasteners. Class 2B is a realistic approach to the tolerances required in the production of standard nuts.

"Changing to Classes 2A and 2B does not affect strength or interchangeability. Components are mechanically and functionally interchangeable in any combinations of the old and new classes.

"Specification and adoption of these new classes of thread into actual practice will require restraint on the part of the users in order to afford manufacturers opportunity for reduction of present inventories of finished product and the working off of current stocks of tools and raw materials.

"To implement change-over to the new classes of thread, users for an indeterminate period specify the new classes but permit the old classes as optional. Conversely when specifications are not changed, users should accept the new classes as optional.

* Previous report on Project B1 appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 316.

"Producers and users have agreed that implementation of the new standards should proceed as rapidly as transition can be effected, and that inspection should be governed accordingly. They recommend, however, that for the time being neither the new nor the old classes as they apply to screws, bolts, nuts and similar threaded fasteners, should be mandatory except for specific applications agreed upon by consumer and producer."

Action Recommended

Acceptance as information.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION PLAIN AND LOCK WASHERS—PROJECT B27

W. G. Brown, Representative

Project B27 is divided into two Standards: B27.1 for Lock Washers, and B27.2 for Plain Washers.

The following is taken from the magazine, "Standardization," January 1950 issue:

"A proposed revision of American Standard Lock Washers, B27.1-1944 has been submitted to the Sectional Committee for letter ballot vote. Early in 1945, industry and government services experienced serious difficulty with lock washer failure due to hydrogen embrittlement. Joint industry conferences recommended after investigation that users and producers adopt the American Standard as a corrective measure. Minor revisions were also recommended with respect to hardness range and methods of test. It was decided to prepare a revision of the 1944 Standard, which revision has now been completed. The new text comprises proposals on spring lock washer and machine screw assemblies, tooth lock washers, tooth lock washer and machine screw assemblies, and spring lock washers of materials other than carbon steel, including stainless steel, phosphor bronze, silicon bronze, aluminum zinc alloy and K-Monel metal."

In the magazine, "Standardization," October 1949—American Standard B27.2-1949—Plain Washers for Use with American Standard Bolt Heads, Nuts and Screws, is listed as having been approved.

Action Recommended

Acceptance as information.

COMMITTEE VII—MATERIALS RESEARCH

Personnel

E. A. Burgin, Chairman	
K. Chamberlain, Vice-Chairman	
F. E. Beutler	Curtis Kies
G. L. Black	J. I. Kirsch
J. P. Coleman	H. C. Lorenzen
A. L. Essman	C. T. Marak
G. E. Goepfert	L. B. Sinclair
T. T. Hart	P. A. Starck
W. W. Hartzell	T. B. Thompson
J. C. Hoffman	W. K. Waltz

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on rust preventives, segregating into classifications.
4. Investigate and report on means for determining colors for target enamel covered in Specification 227, Manual Part 235, and prepare recommended colors.
5. Investigate and report on the possibilities of plastics as a substitute for other materials in signal work.
6. Investigate and report on the use of stainless steel guy and messenger strand.
7. Investigate and report on a substitute for wood for use on electric crossing gate arms.
8. Investigate and report on test installations of aluminum or newer or better steel alloys for relay and instrument housings.
9. Investigate and report on materials and methods for identification of wiring.

The Committee submits for consideration, reports on, the following subjects*:

1. Revision of Specification 201-43, Manual Part 65.
Revision of Specification 46-41, Manual Part 108.
Revision of Specification 120-48, Manual Part 110.
Revision of Specification for Gray Iron Castings, Manual Part 88.
Revision of Specification for Malleable Iron Castings, Manual Part 89.
Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.
4. Specification for Signal Colors Exclusive of Signal Glasses.
Cooperative Report. American Standards Association—Electrical Insulating Materials in General—Project C59.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.S.A.—American Standards Association, 70 E. 45th St., New York 17, N. Y.
A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Federal Specifications—Superintendent of Documents, Government Printing Office, Washington 25, D. C.

N.E.M.A.—National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee VII at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

Specification 251-49—Paint for Finishing Coats on Wood Structures—Now in Manual Part 264.

Specification 252-49—Paint for Finishing Coats on Steel and Iron Structures—Now in Manual Part 265.

Specification 253-49—Enamel Paint for Finishing Coats on Wood Structures—Now in Manual Part 266.

Specification 250-49—Pressure Gun Grease—Now in Manual Part 267.

Specification for Electrolyte—Now in Manual Part 13.

Specification 53-49—Lead Acid Stationary Storage Battery—Positive Plates of Composite Structure Supporting Active Material in the Form of Pure Lead—Now in Manual Part 18.

Specifications for Various Types of Non-Ferrous Metals and Alloys—Now in Manual Part 220.

(Revision of A.A.R. Signal Section Specification 201-43)
A.A.R. SIGNAL SECTION SPECIFICATION 201-50.

PRIMER PAINT, RED LEAD BASE, FOR STEEL
AND IRON STRUCTURES

1. *Purpose.*

(a) This specification is for the purpose of providing a red lead base primer paint for steel and iron structures. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. *Tender.*

(a) The tender shall be for material and workmanship meeting the requirements of this specification in its entirety.

3. *Material and workmanship.*

(a) Material and workmanship shall be first-class in every respect.

4. *Types of paint.*

(a) Primer paint, ready mixed, shall be in accordance with, and meet the requirements of, Federal Specification TT-P-86a dated May 4, 1949, Types I, II or III, as follows:

Type I

1. Red lead—linseed oil paint, TT-P-86a, Type I. (This type is recommended for either field or shop use. It is a slow-drying material which adheres well to metal surfaces even in the presence of limited amounts of rust and scale found impractical to remove. It dries for handling and recoating, under normal drying conditions, within 24 to 36 hours, with low gloss, and forms a tough protective film providing an excellent base for subsequent coats.)

Type II

2. Red lead mixed pigment—alkyd varnish—linseed oil paint, TT-P-86a, Type II. (This type is recommended for either field or shop use. Under normal drying conditions, it dries for handling within 6 to 8 hours, and can be recoated within 18 hours. It provides a strongly adhering, flexible abrasion-resistant coating, having low gloss, with a brownish red color characteristic.)

4. *Types of paint.*—Continued.*Type III*

3. Red lead—alkyd varnish paint, TT-P-86a, Type III. (This paint is recommended for shop use only. Under normal drying conditions, it dries for handling and recoating within 4 to 6 hours. It is essential that this paint be applied only to well-cleaned surfaces.)

(b) Primer paint, mixed by Purchaser to make the equivalent of Type I specified in section 4-a-1, shall be in accordance with the following:

1. From dry red lead:

Dry red lead A.S.T.M. D 83.....	25 lbs.
Linseed replacement oil, Federal Specification TT-O-371, Type I.....	1 gal.
Total (approx.).....	1 $\frac{1}{8}$ gals.

Gals. Lbs.

2. From paste red lead:

Paste red lead, 97 per cent grade, A.S.T.M. D 83.....	2 $\frac{1}{4}$	100.0
Linseed replacement oil, Federal Specification TT-O-371, Type I.....	2 $\frac{1}{4}$	16.8
Volatile thinner (Turpentine A.S.T.M. D 233 or petroleum spirits A.S.T.M. D 235).....	$\frac{3}{8}$	2.6
Total.....	4 $\frac{7}{8}$	119.4

5. *Purchaser's order.*

(a) Purchaser's order shall specify the following:

1. Type of ready mixed paint.

2. Material for mixing.

(a) Dry red lead, A.S.T.M. D 83.

(b) Paste red lead, 97 per cent grade, A.S.T.M. D 83.

(c) Linseed replacement oil, Federal Specification TT-O-371, Type I.

(d) Turpentine, A.S.T.M. D 233.

(e) Petroleum spirits, A.S.T.M. D 235.

3. Size of shipping containers.

6. *Application.*

(a) Application of red lead primer paint shall be in accordance with, and meet the requirements of, Specification 120, Manual Part 110.

7. *Inspection.*

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

7. *Inspection.*—Continued.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

(e) If requested by the Purchaser, the Contractor shall furnish certificate of test certifying that the material meets the requirements of this specification.

8. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Contractor shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

9. *Shipping containers.*

(a) Material shall be shipped in containers specified by the Purchaser as follows:

1. Red lead primer paint, ready mixed, in 1 quart, 1 or 5 gallon cans; or in 20 or 30 gallon drums.
2. Dry red lead or paste red lead in 12½, 25, or 50 pound pails; or 100 pound kegs.
3. Linseed replacement oil in 1 or 5 gallon cans.
4. Turpentine or petroleum spirits in 1 pint, 1 quart, or 1 gallon cans.

10. *Packing.*

(a) Material shall be so prepared as to permit convenient handling and to protect against loss or damage during shipment.

11. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of package.

(b) Detail list of loose pieces, containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown,

12. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production, any part or parts to replace those which shall be found defective within three months after shipment to the Purchaser. This warranty shall not apply to any material which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 201-43—Primer Paint for Steel and
Iron Structures, Manual Part 65.

(Revision of A.A.R. Signal Section Specification 46-41)
A.A.R. SIGNAL SECTION SPECIFICATION 46-50.

TRANSFORMER OIL

1. Purpose.

(a) This specification is for the purpose of providing oil for cooling and insulating oil-immersed transformers. It sets forth specific detail requirements representing modern signal practice recommended for new installations and for the replacement of existing material when general renewal or replacement becomes desirable.

2. Tender.

(a) The tender shall be for oil meeting the requirements of this specification in its entirety.

3. Material and workmanship.

(a) Material and workmanship shall be first-class in every respect.

(b) The oil shall be pure mineral oil obtained by fractional distillation of petroleum and shall not contain any substances which will injuriously affect its electrical insulation properties.

(c) The oil shall conform to the following requirements:

1. Color: A.S.T.M. No. 3 N.P.A. or lighter, transparent (lemon pale).
2. Flash: 269 deg. F. minimum.
3. Fire: 298 deg. F. minimum.
4. Pour point: Minus 40 deg. F. maximum.
5. Viscosity: S.U. at 100 deg. F., 57 seconds maximum.
6. Total acidity: (neutralization number) 0.05 maximum.
7. Mineral acids: (water soluble) Nil.
8. Alkali: Nil.
9. Free sulphur: Nil.
10. Inorganic chlorides and sulphates: Nil.
11. Free water: None.
12. Dielectric strength: 22 kv. minimum.

4. Inspection.

(a) Purchaser may inspect material at all stages of manufacture.

(b) Purchaser may inspect the completed product to determine that the requirements of this specification have been met.

(c) If material has not been accepted at point of production and if, upon arrival at destination, it does not meet the requirements of this specification, it may be rejected, and the Contractor, upon request, shall advise the Purchaser what disposition is to be made of the rejected material. Contractor shall pay all freight charges.

(d) If Purchaser is to make inspection at point of production it shall be so stated on Purchaser's order.

5. *Tests.*

(a) Tests may be made at point of production, or on samples submitted, and may also be made at destination.

(b) Contractor shall give the Purchaser sufficient notice of time when material will be ready for testing.

(c) Contractor shall provide, at point of production, apparatus and labor for making required tests under supervision of the Purchaser.

(d) If tests are to be made at point of production, it shall be so stated on Purchaser's order. The Purchaser shall indicate which of the tests herein specified are to be made and what portion of the material shall be tested.

(e) All tests shall be made in accordance with current A.S.T.M. method:

1. Sampling—A.S.T.M. D 923.
2. Color—A.S.T.M. D 155.
3. Flash and fire—A.S.T.M. D 92.
4. Pour point—A.S.T.M. D 97.
5. Viscosity—A.S.T.M. D 88.
6. Neutralization number—A.S.T.M. D 974 or D 664.
7. Mineral acid—A.S.T.M. D 117.
8. Alkali—A.S.T.M. D 974 or D 664.
9. Free sulphur—A.S.T.M. D 989.
10. Inorganic chlorides and sulphates—A.S.T.M. D 878.
11. Free water—A.S.T.M. D 96.
12. Dielectric strength—A.S.T.M. D 877.

6. *Packing.*

(a) Oil shall be furnished in clean, dry, hermetically sealed containers of a size as specified by the Purchaser and shall be so protected as to permit convenient handling and to protect against loss or damage during shipment.

7. *Marking.*

(a) Purchaser's order, requisition and package number, name of Consignor, and name and address of Consignee, shall be plainly marked on outside of container.

(b) Detail list of containers and their contents shall be furnished for each shipment. Where carload shipments are made, routing and car identification shall be shown.

8. *Warranty.*

(a) Contractor shall warrant the material covered by this specification to be free from defects in material and workmanship under ordinary use and service, his obligation under this warranty being limited to manufacturing, at point of production,

8. *Warranty.*—Continued.

any part or parts to replace those which shall be found defective within 60 days after shipment to the Purchaser. This warranty shall not apply to any material which has been subjected to misuse, negligence or accident.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 46-41—Transformer Oil, Manual Part 108.

(Revision of A.A.R. Signal Section Specification 120-48)
A.A.R. SIGNAL SECTION SPECIFICATION 120-50.

PAINT AND PAINTING

*Proposed Revision*9. *Prescribed paint coatings.*

(1) Wood arms for highway grade crossing gates shall be given one coat of primer paint, Specification 238, Manual Part 246, followed by two coats of paint, Specification 251, Manual Part 264, color and striping to conform to Drawing 1491, 1492, 1493 or 1494. *R-9-1.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 9-1 of Specification 120-48—Paint and Painting,
Manual Part 110.

SPECIFICATION FOR SIGNAL COLORS
EXCLUSIVE OF SIGNAL GLASSES

1950

The following colors are recommended for switch targets, interlocking machine levers, semaphore signal blades and similar equipment:

Red —Army-Navy Aircraft Standard Color No. 509, "Insigna Red."
Yellow—Army-Navy Aircraft Standard Color No. 506, "Orange Yellow."
Blue —Army-Navy Aircraft Standard Color No. 501, "Light Blue."
White —Army-Navy Aircraft Standard Color No. 511, "Insigna White."
Black —Army-Navy Aircraft Standard Color No. 515, "Gloss Black."
Green —U.S. Army Medium Green No. 112 as shown on the Color Card Supplement to U.S. Army Specification No. 3-1, Revised April 21, 1943.

Note.—Army-Navy Aircraft Standard Colors were issued by the Department of the Navy, Bureau of Aeronautics, Washington 25, D. C. in March 1945.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of Specification for Gray Iron Castings)

SPECIFICATION FOR GRAY IRON CASTINGS

1950

The recommended specification for gray iron castings is current Specification A 48 of the American Society for Testing Materials, which shows the following classifications and minimum tensile strength requirements:

Class No.	Tensile strength min., psi.
20	20,000
25	25,000
30	30,000
35	35,000
40	40,000
50	50,000
60	60,000

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification for Gray Iron Castings, Manual Part 88.

(Revision of Specification for Malleable Iron Castings)

SPECIFICATION FOR MALLEABLE IRON CASTINGS

1950

The recommended specification for malleable iron castings is current Specification A 47 of the American Society for Testing Materials, which shows the following minimum requirements of the two grades of malleable iron:

	Grade No. 32510	Grade No. 35018
Tensile strength, min., psi.....	50,000	53,000
Yield point, min., psi.....	32,500	35,000
Elongation in 2 in., per cent.....	10	18

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification for Malleable Iron Castings, Manual Part 89.

(Revision of Specifications for Various Types of Non-Ferrous Metals and Alloys)

SPECIFICATIONS FOR VARIOUS TYPES OF
NON-FERROUS METALS AND ALLOYS

1950

The recommended specifications for various types of non-ferrous metals and alloys shall meet the requirements of current specifications of the American Society for Testing Materials, for applications as follows:

1. Binding posts and screws with cold upset heads and rolled threads:
 - (a) B 98 —Copper-Silicon Alloy Rods, Bars, and Shapes, Alloy B, extra-hard, bolt temper.
 - (b) B 164 —Nickel-Copper Alloy Rods and Bars, Class A, cold-drawn.
2. Binding posts and screws, machine-cut:
 - (a) B 98 —Copper-Silicon Alloy Rods, Bars and Shapes, Alloy D, hard temper.
 - (b) B 164 —Nickel-Copper Alloy Rods and Bars, Class B, cold-drawn.
 - (c) B 140 —Leaded Red Brass (Hardware Bronze) Rods, Bars and Shapes, Alloy B, half-hard temper.
3. Nuts for binding posts and general purposes:
 - (a) B 16 —Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper.
4. Machine-cut screws other than for use as binding posts:
 - (a) B 139 —Phosphor Bronze Rods, Bars and Shapes, Alloy as required. (For screws, shafts, bushings, trunnions and other structural parts.)
 - (b) B 140 —Leaded Red Brass (Hardware Bronze) Rods, Bars, and Shapes, Alloy B, half-hard temper.
 - (c) B 16 —Free-Cutting Brass Rod and Bar for Use in Screw Machines, half-hard temper. (Not to be used for securing vital parts.)
5. Commercial screws with cold upset head and rolled threads:
 - (a) B 134 —Brass Wire, Alloy No. 7, eighth hard temper.
6. Washers for use on binding posts:
 - (a) B 152 —Copper Sheet, Strip, and Plate, Type ETP cold-rolled hard temper.
7. General purpose washers and structural parts:
 - (a) B 97 —Copper-Silicon Alloy Plate, Sheet and Strip for General Purposes, type and temper as required.
 - (b) B 127 —Nickel-Copper Alloy Plate, Sheet, and Strip, finish and temper as required.
 - (c) B 36 —Brass Plate, Sheet and Strip, Alloy number and temper as required.

7. General purpose washers and structural parts—Continued:
- (d) B 152 —Copper Sheet, Strip, and Plate, type and temper as required.
 - (e) B 122 —Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy number and temper as required.
 - (f) B 103 —Phosphor Bronze Plate, Sheet and Strip, grade and temper as required.
 - (g) B 209 —Aluminum and Aluminum Alloy Sheet and Plate, alloy number and temper as required.
 - (h) B 211 —Aluminum and Aluminum-Alloy Bars, Rods, and Wire, alloy number and temper as required.
 - (i) B 194 —Beryllium Copper Alloy Strip.
8. Spring contacts:
- (a) B 103 —Phosphor Bronze Plate, Sheet and Strip, grade and temper as required.
 - (b) B 122 —Copper-Nickel-Zinc and Copper-Nickel Alloy Plate, Sheet and Strip, alloy and temper as required.
 - (c) B 162 —Nickel Plate, Sheet and Strip, temper as required.
9. Connectors:
- (a) B 152 —Copper Sheet, Strip and Plate, Type ETP temper as required.
10. Coiled springs:
- (a) B 159 —Phosphor Bronze Wire, grade and temper as required.
 - (b) B 197 —Beryllium Copper Alloy Wire.
11. Die castings:
- (a) B 85 —Aluminum Base Alloy Die Castings, alloy number as required.
12. Sand castings:
- (a) B 26 —Aluminum Base Alloy Sand Castings, alloy number and treatment as required.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specifications for Various Types of Non-Ferrous Metals and Alloys,
Manual Part 220.

COOPERATIVE REPORT

AMERICAN STANDARDS ASSOCIATION
ELECTRICAL INSULATING MATERIALS IN GENERAL—
PROJECT C59*

J. I. Kirsch, Representative

A meeting of Sectional Committee C59 on Electrical Insulating Materials was held in Washington, D. C. on November 29, 1949.

(A) Consideration was given the following items for submission to the A.S.A. for approval:

A.S.T.M. Specification and Methods of Test for Asbestos Tape for Electrical Purposes (D 315-49), and

A.S.T.M. Specification and Methods of Test for Asbestos Roving for Electrical Purposes (D 375-49).

Mr. O. E. Anderson, who, with Mr. R. H. Titley, was assigned to review these items, stated that these two specifications define a standard atmosphere of 65 per cent relative humidity at 70 F. (21 C.) which is not consistent with the Standard Laboratory Atmosphere defined in Methods of Conditioning Plastics and Electrical Insulating Materials for Testing (D 618-47). The Committee felt that submittal to the A.S.A. should be withheld, pending discussion with Committee D-13 looking toward bringing the conditioning requirements in line with the standard conditions.

Later, it was moved by Mr. Mapes, seconded by Mr. Evans and unanimously VOTED that the matter of bringing the conditioning requirements in all of the electrical textile standards in line with the Standard Conditions be discussed with Committee D-13.

A.S.T.M. Method for Sampling Electrical Insulating Oils (D 923-49),

A.S.T.M. Specification for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors (D 748-49),

A.S.T.M. Method of Test for Power Factor and Dielectric Constant of Electrical Insulating Oils of Petroleum Origin (D 924-49),

A.S.T.M. Methods of Test for Gas Content of Insulating Oils (D 831-48),

A.S.T.M. Method of Test for Inorganic Chlorides and Sulphates in Insulating Oils (D 878-49),

A.S.T.M. Method of Test for Detection of Free Sulphur in Electrical Insulating Oils (D 989-48T),

N.E.M.A. Standards for Laminated Thermosetting Products (C59.16-1949):

Recommended to be submitted to letter ballot of the Sectional Committee looking toward approval as American standard and which, upon motion, was approved.

* Previous report on Project C59 appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 346 and 470.

A.S.T.M. Methods of Testing Sheet and Plate Materials Used in Electrical Insulation (D 229-46; A.S.A. C59.13-1948):

Reported upon by Mr. Anderson who recommended that the revisions adopted by Committee D-9 be submitted to letter ballot of the Sectional Committee looking toward approval as American Standard. Mr. Anderson did not recommend the addition of the new Section 49 to A.S.A. C59.13-1948, in view of the action taken by Committee D-9, withdrawing approval of advancement to standard on this item. On motion, this recommendation was approved.

(B) Consideration of Additional Standards for Recommendation to the A.S.A. for Approval developed that no other standards were to be presented at this time.

(C) Status of Review of JAN Specifications Submitted by the Armed Services Electro Standards Agency—It was voted at the last meeting of the committee that a number of JAN Specifications, submitted by the Munitions Board for approval as American Standard, (Min. 181), be referred to Committee D-9, requesting that a conference be called of representatives of government services and industry to attempt to reconcile differences between A.S.T.M., Federal and JAN Specifications. Mr. Hatcher, Chairman of Committee D-9, stated that he did not have a complete report as yet. N.E.M.A. and the Navy are working on certain changes and the general plan is to have A.S.T.M. Standards conform with the Navy as soon as differences can be reconciled. Progress is being made, but no action has been taken as yet.

Col. Frame, reporting on changes in JAN Specifications, stated that some test requirements have been changed and he would check to be sure that these have been passed along.

(D) Report by Mr. E. A. Snyder, Technical Adviser to the U.S. National Committee of the I.E.C. on Insulating Oils—Mr. Snyder reported that a meeting of Advisory Committee No. 10 on Insulating Oils had been held in Stresa, Italy, on June 13, 14 and 15. Mr. F. M. Clark, Chairman of Section B, Subcommittee IV of A.S.T.M. Committee D-9, attended this meeting as U.S. representative and had been appointed chairman of a subcommittee which was to develop an international aging test method. Specifications were set up for this work for which there was unanimous agreement. Samples of oil will be sent to each member, who will run tests along the lines laid out and report the results. The work is well under way and well organized.

Mr. Snyder stated it had been reported that a committee had been set up in CIGRE, similar to that in the I.E.C., but that the Secretary of the U.S. CIGRE committee had explained that this is not a working committee, but a discussion committee, and steps will be taken to avoid any duplication of effort. A meeting will be held in New York with the Chairman and Secretary of the U.S. CIGRE committee, Messrs. Clark, McNair and Snyder, to review this matter to make sure that no duplication of effort is involved.

After considerable discussion of transformer oils, silicon oils and cable oils, the I.E.C. Committee unanimously agreed that its work for the present should be confined to transformer oils.

(E) Report by Mr. W. H. Gardner, Technical Advisor to the U.S. National Committee of the I.E.C. on Shellac—The Secretary had received no report from Mr. Gardner. The Secretary reported he understood that the work of this Advisory Committee is being extended to cover insulation in general. He was instructed to make inquiry as to Mr. Gardner's status and whether in view of the broadening in scope of this Advisory Committee (No. 15) any change will be made in the handling of this contact work.

(F) Report on Status of I.S.O. Committee on Mica—The Secretary received copy of a letter to Mr. J. W. McNair from Mr. S. M. Hunn, Jr., Recording Secretary, Manufactured Electrical Mica Section of N.E.M.A., with respect to the procedure dealing with mica so far as the I.S.O. set-up is concerned. The question had also been raised as to whether this I.S.O. contact should be handled through Committee C59 or Subcommittee IX of Committee D-9. It was suggested that a group set up by Committee C59 could review reports from D-9, or Subcommittee IX could send its data to such a group which would then write the report, or Committee C59 could look to Subcommittee IX of D-9 as the group to represent the American viewpoint in these discussions on mica. It was moved by Mr. Titley, seconded by Mr. Hausmann, and unanimously VOTED that Sectional Committee C59 recognize Subcommittee IX of A.S.T.M. Committee D-9 as the American Committee to deal with discussions in the I.S.O. Committee on Mica, provided that this group keep the Sectional Committee informed of the progress of the work.

The attention of the Committee was called to the fact that the I.S.O. Committee on Mica held a meeting in Delhi, India, in January 1950 and Mr. Hausmann reported that Subcommittee IX had taken action recommending that a letter be sent by A.S.T.M. Headquarters to the Western Electric Co., suggesting that Mr. B. A. Gerpheide (Chairman of Section A of Subcommittee IX) be authorized to attend this meeting; or, as an alternate, the Asheville-Schoonmaker Mica Co., which has two representatives in India, might have one or both attend the Delhi meeting as official American representatives.

(G) Report on Status of I.S.O. Committee on Shellac—The Secretary reported that the American Committee on Shellac had held a meeting in New York and a report was drafted for transmission to the Indian Standards Institution, for presentation at the meeting of the I.S.O. Committee in Delhi in January 1950.

Action Recommended

Acceptance as information.

COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION

Personnel

W. H. Stilwell, Chairman

H. T. Fleisher, Vice-Chairman

H. A. Appleby	R. H. Smedley
S. B. Higginbottom	W. R. Smylie
J. E. K. Krylow	J. G. Stonehouse
S. W. Law	C. H. Tillett
H. G. Morgan	J. L. Weatherby
E. N. Pearson	L. S. Werthmuller
W. F. Price	A. W. Wilson
H. C. Sampson	H. D. Blake*
E. J. Seybold	R. B. Elsworth*

H. A. Franklin*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on any development on highway grade crossing protection.
4. Illumination of crossings.
5. Investigate and report on the use of diffusing lenses in electric light units for highway crossing signals to provide a wider range of indication where a long view is not required.
6. Prepare typical location plans for highway grade crossing protection devices.
7. Investigate and report on the durability and methods of maintenance of reflectorized signs.
8. Investigate and report on methods for focusing and aligning railroad highway grade crossing flashing light signals in the field.
9. Investigate and report on the use of reflecting materials for backgrounds on signs covered by Drawings 1491, 1642, 1643, 1645, 1646, 1648, 1691, 1692 and 1693, collaborating with A.R.E.A. Committee 9.

The Committee submits for consideration, reports on the following subjects**:

1. Revision of Requisites for Automatic Gates—Highway Crossings at Grade Over Railroad Tracks, Manual Part 35.

Revision of Requisites for Highway Grade Crossing Signals, Manual Part 148.

* Consulting Member.

** Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Revision of Requisites for "No Right Turn" and "No Left Turn" Signs for Highway Crossings at Grade Over Railroad Tracks, Manual Part 224.

Revision of Specification 209-44, Manual Part 179.

Requisites for Control of Automatic Highway Grade Crossing Signals and Devices.

Information

Specifications, etc., of other organizations referred to in the report of this Committee may be procured from the following:

A.I.E.E.—American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

Disposition of 1949 Letter Ballot Subjects

The following subjects presented by Committee VIII at the 1949 Annual Meeting were submitted to letter ballot and officially approved:

Instructions for Focusing and Aligning Railroad Highway Grade Crossing Flashing Light Signal Units, Reflector Type, with Sealed Lamp Receptacle—Now in Manual Part 268.

Signs Used in Connection with Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs—Now in Manual Part 269.

A.A.R. SIGNAL SECTION REQUISITES.

CONTROL OF AUTOMATIC HIGHWAY GRADE CROSSING
SIGNALS AND DEVICES

1950

1. *Purpose.*

(a) The purpose of these requisites for control of automatic highway grade crossing signals and devices is to set forth the general requirements representing modern practices recommended for new installations and the replacement of existing installations when general renewal or replacement becomes desirable.

2. *Signals and devices.*

(a) For highway grade crossing signals, see Requisites for Highway Grade Crossing Signals, Manual Part 148.

(b) For automatic gates, see Requisites for Automatic Gates—Highway Crossings at Grade Over Railroad Tracks, Manual Part 35.

(c) For "No Right Turn" and "No Left Turn" signals, see Requisites for "No Right Turn" and "No Left Turn" Signals for Highway Crossings at Grade over Railroad Tracks, Manual Part 224.

3. *General.*

(a) Signals and devices which indicate the approach of a train shall be so controlled that they will operate for such period of time before the arrival of any train operated over the crossing as is reasonably required to afford protection.

(b) Controls shall conform to Requisites for Automatic Block Signaling Circuits, Manual Part 34, in so far as they apply, and as far as practicable shall be so designed that in the event of failure of any part, the required operating time of the signals and devices will be assured.

(c) Where means are provided for cutting out the protective devices during intervals when trains make regular operating stops or perform switching operations on approach circuits:

1. Controls shall be so designed as to insure required operating time of protective devices, when the train again proceeds toward the crossing.

2. Automatic control of the protective devices actuated by approaching trains other than the train that has stopped or is performing switching operations, shall take precedence over any cut-out features.

(d) Where manual supervisory control of protective devices is provided in addition to automatic controls:

1. Automatic control actuated by approaching trains other than that for which manual control has been made effective shall take precedence over the manual control.

3. General.—Continued.

2. Means shall be provided to insure restoring of the controls to automatic operation.
3. Means shall be provided to prevent manual operation by unauthorized persons.

4. Controls for highway grade crossing signals.

(a) Where the distance from the most remote signal to the clearance on the highway for the farthest track on which trains operate at medium or higher speed, as measured parallel to the center line of the highway, is 35 ft. or less, the signals shall operate for not less than 20 seconds before the arrival of any train on such track. Where this distance is more than 35 ft., the minimum time should be increased by 1 second for each additional 10 ft.

(b) For trains in either direction on main tracks over which trains normally operate in either direction, and for trains moving with the current of traffic on main tracks over which trains normally operate in one direction only, signals shall operate until the rear of the train clears the crossing.

(c) Where reverse running is frequent on main tracks, consideration shall be given to meeting the same requirement as where trains normally operate in either direction on main track.

(d) Where train speeds on a given track vary considerably, a single operating circuit of such length as to provide adequate warning of the approach of trains at the higher speed may produce too long a warning time for slower trains. In such cases, additional operating circuits may be provided with timing devices so arranged that a warning time, not too long for the slower trains, will be automatically selected.

(e) Bell, when used, shall sound a warning from the time the signal lights start to operate at least until the head end of the train has passed the crossing.

5. Controls for automatic gates.

(a) The gate arm lights shall operate in conjunction with the highway grade crossing signal, as follows:

1. Lights shall operate at all times when the gate is in position to obstruct highway traffic.
2. Light nearest the tip of arm shall burn steadily.
3. Two lights shall flash alternately and in unison with the lights on the signal.

(b) Gate arm shall start its downward motion not less than 3 seconds after the signal lights start to operate.

(c) Gate arm shall reach full horizontal position before arrival of any train on a main track and shall remain in that position until the rear of the train has cleared the crossing.

(d) Circuits shall be so arranged that a failure of the gate mechanism to operate as intended will not prevent the lights on gate arm and signal from operating on the approach of a train.

(e) Bell, when used, shall sound a warning from the time the signal lights start to operate at least until the gate arm has descended to within 10 deg. of the horizontal position.

6. *Controls for "No Right Turn" and "No Left Turn" signals.*

(a) Sign shall be illuminated without flashing during the period that the crossing signals are operating.

(b) The yellow marker located above the sign shall flash in synchronism with the crossing signals.

Action Recommended

Acceptance for submission to letter ballot.

(Revision of Requisites for Automatic Gates—Highway Crossings
at Grade Over Railroad Tracks)
A.A.R. SIGNAL SECTION REQUISITES.

AUTOMATIC GATES
HIGHWAY CROSSINGS AT GRADE OVER RAILROAD TRACKS

1950

1. *Aspect.*

(a) An automatic gate used for the protection of highway traffic at a railroad highway grade crossing, when indicating the approach of a train, shall present toward approaching highway traffic the aspect of an arm equipped with red lights being lowered across the lane or lanes used by traffic approaching the crossing or at rest in the horizontal position across the lane or lanes.

2. *Mounting.*

(a) An automatic gate, when installed, shall serve as an adjunct to a highway crossing signal of the flashing light type.

1. When used as an adjunct to signal shown on Drawing 1653, it shall conform to Drawing 1462 or 1489.

2. When used as an adjunct to signal shown on Drawing 1686 or 1688, it may be separately mounted on an independent pipe post or pedestal located between the signal and the track.

(b) Automatic gate installation shall be in accordance with Specification 209, Manual Part 179.

(c) One gate shall be placed on each side of the track preferably to the right of approaching highway traffic.

3. *Arm.*

(a) Gate arm shall conform to Drawing 1491 or 1493.

(b) Each gate arm shall be equipped with not less than three red electric light units arranged to shine in both directions along the highway.

(c) The gate arm, when in the raised position, shall not obstruct or interfere with highway traffic.

4. Mechanism.

(a) Mechanism shall be in accordance with Specification 199, Manual Part 194.

5. Operation.

(a) Controls for gate and signal operation shall be in accordance with Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part

6. Bell.

(a) Bell, where required by public authority or special conditions, shall be in accordance with Specification 44, Manual Part 21.

1. Bell, when used, should be mounted preferably on the mast supporting the crossing signal, with the face of the gong parallel to the highway.

2. Size and range of bell shall be determined by local conditions.

7. Highway marking.

(a) The highway traffic lanes in the vicinity of the crossing should be distinctly marked.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Automatic Gates—Highway Crossings at Grade Over Railroad Tracks, Manual Part 35.

(Revision of Requisites for Highway Grade Crossing Signals)
A.A.R. SIGNAL SECTION REQUISITES.

HIGHWAY GRADE CROSSING SIGNALS

1950

1. Purpose.

(a) The purpose of these requisites for highway grade crossing signals is to set forth the general requirements representing modern practices recommended for new installations and the replacement of existing installations when general renewal or replacement becomes desirable.

2. Aspect.

(a) A signal used for the protection of traffic at a railroad highway grade crossing shall present an aspect toward approaching highway traffic conforming to Drawing 1651, 1652, 1653, 1654, 1686 or 1688. The operative part of the signal, when indicating the approach of a train, shall present the appearance of a horizontally swinging red light or swinging disc.

3. *Mounting.*

(a) Either flashing light type or wig-wag type signals may be used, but both should not be used at the same crossing.

(b) One signal shall be placed on each side of the track preferably to the right of approaching highway traffic.

4. *Painting.*

(a) Discs and signs shall be painted as necessary to conform to Drawings 1553, 1640, 1643, 1644, 1650, 1693, 1700, 1701, 1702, 1703 and 1704.

(b) Parts which function as background for light signal indications shall be painted with non-reflecting black in accordance with Specification 214, Manual Part 221.

(c) All other parts shall be painted white or aluminum.

5. *Operation.*

(a) Controls for signal operation shall be in accordance with Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part

6. *Bell.*

(a) Bell, where required by public authority or special conditions, shall be in accordance with Specification 44, Manual Part 21.

1. Bell, when used, should be mounted preferably on the mast supporting the crossing signal, with the face of the gong parallel to the highway.

2. Size and range of bell shall be determined by local conditions.

Flashing Light Type

7. *Electric light units.*

(a) Electric light units shall be in accordance with Specification 190, Manual Part 166, or Specification 232, Manual Part 244, and shall be arranged to shine in both directions along the highway. They shall be mounted horizontally 2 ft. 6 in. centers and preferably not less than 7 ft. nor more than 9 ft. above the surface of the highway.

8. *Flashes.*

(a) Electric lamps shall flash alternately. The number of flashes of each electric lamp per minute shall be 30 minimum, 45 maximum. Electric lamps shall each burn approximately the same length of time. Total burning time of both electric lamps shall be practically the entire operating time.

Wig-Wag Type

9. *Electric light units.*

(a) Electric light units shall shine in both directions along the highway.

10. Lenses or roundels.

(a) Lenses or roundels shall be highway crossing red 5 in. diameter minimum and in accordance with Specification 69, Manual Part 136.

11. Range and spread.

(a) The electric light unit, when the disc is suspended vertically, shall have a range, at night, of 1,500 ft. through a total angle of not less than 20 deg. when a 10-watt lamp rated at 1,000 hours is burned at rated voltage.

12. Cycles.

(a) Movement from one extreme to the other and back constitutes a cycle. The number of cycles per minute shall be 30 minimum, 45 maximum.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Requisites for Highway Grade Crossing Signals, Manual Part 148.

(Revision of Requisites for "No Right Turn" and "No Left Turn"
Signs for Highway Crossings at Grade Over Railroad Tracks)
A.A.R. SIGNAL SECTION REQUISITES.

**"NO RIGHT TURN" AND "NO LEFT TURN" SIGNALS FOR
HIGHWAY CROSSINGS AT GRADE OVER RAILROAD TRACKS**

1950

1. *Application.*

(a) On highways adjacent to and approximately paralleling a railroad, which intersect or join another highway that crosses the railroad, signals displaying the legend "No Right Turn" or "No Left Turn" on the approach of a train may be used to supplement the highway grade crossing signals which are located at the crossing.

2. *Aspect.*

(a) The aspect shall be that of an illuminated sign bearing the legend "No Right Turn" or "No Left Turn" surmounted by a flashing yellow marker light.

3. *Mounting.*

(a) Signal shall be placed preferably to the right of the parallel highway approaching the crossing and as close to the intersection as practicable.

(b) The center of the sign shall be not less than 7 ft. nor more than 9 ft. above the surface of the highway, and the center of the marker shall be approximately 2 ft. higher.

(c) Mounting of sign and marker on mast shall conform to Drawing 1482 or 1483.

4. *Design and assembly.*

(a) Signal shall conform to Drawing 1488.

(b) Sign shall conform to Drawing 1481.

(c) Sign shall be in accordance with Specification 231, Manual Part 237.

(d) Marker shall be in accordance with Specification 190, Manual Part 166, or Specification 232, Manual Part 244, except to display yellow and arranged for fastening to bracket, Drawing 1485.

5. *Operation.*

(a) Controls for the operation of the signal shall be in accordance with Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Requisites for "No Right Turn" and "No Left Turn" Signs for Highway
Crossings at Grade Over Railroad Tracks, Manual Part 224.

(Revision of A.A.R. Signal Section Specification 209-44)
A.A.R. SIGNAL SECTION SPECIFICATION 209-50.

HIGHWAY GRADE CROSSING AUTOMATIC GATES

General Provisions

1. *Details of work.*

- (a) The installation includes the following features:
1. Track to be signaled:
 - (a) Single track.
 - (b) Two track.
 - (c) Multiple track.
 2. Power supply.
 3. Distributing system:
 - (a) Aerial.
 - (b) Surface.
 - (c) Underground.
 4. Foundations.
 5. Signals.
 6. Gates.
 7. Gate operating mechanism.
 8. Conduits and supports.
 9. Wires and cables.
 10. Instrument and battery housings.
 11. Insulation.
 12. Painting.
 13. Bonding.
 14. Energy for operating gates, signals, track circuits, etc.
 15.
 16.

2. *Unit specifications, drawings, requisites and requirements.*

(a) Unit specifications, drawings, requisites and requirements referred to in the body of this specification form an essential part hereof.

3. *Drawings.*

(a) Purchaser's drawings form an essential part of this specification and should include the following information:

1. Track and signal plan drawn to scale showing tracks and highway with grades and alignments; existing and proposed signals and switches, designating their normal position and whether interlocked or non-interlocked; location and capacity of existing junction boxes, relay and battery housings; power stations or source; existing highway crossing protection; pole line or other supports for line wires or aerial cables; kind and condition of ballast and such other physical characteristics or information as is desirable. Drawing , dated

3. *Drawings.*—Continued.

2. Plan showing circuits for the control of crossing signals and gates and any existing circuits that may affect the final circuit arrangement. Drawing, dated

3. Such standards and other drawings as the Purchaser considers desirable. Drawing, dated

(b) Where approval of public authorities is required, this shall be secured by the Purchaser.

4. *Furnished by the Purchaser.*

(a) Purchaser will furnish, as indicated in sections 4-b, c and d, material or labor, or both, on the following items:

1. Ties for support of apparatus.
2. Move ties as may be necessary.
3. Move switch and tie rods as may be necessary.
4. Insulated rail joints.
5. Bridge insulations.
6. Switch-rod insulations.
7. Tie-rod insulations.
8. Gage-plate insulations.
9. Concrete material:
 - (a) Cement.
 - (b) Sand.
 - (c) Stone.
 - (d) Water.

10. Precast concrete foundations.
11. Necessary grading and drainage.
12. Excavation of solid rock.
13. Poles for line wire.
14. Cross-arms, pins, insulators and fittings.
15. Line wire.
16. Battery wells.
17. Aerial cable.
18. Submarine cable.
19. Apply necessary attachments to signal apparatus in service.
20. Make necessary alterations of any part of existing structures or apparatus.
21. Unload and properly house material that arrives on the ground before the Contractor's force; this work to be done under the supervision of the Contractor's representative.
22. Distribute material.
23. Obtain necessary permits from Federal, State and Municipal authorities.
24. Tools, fixtures for building and supplies required for the maintenance of the system.

4. *Furnished by the Purchaser.*—Continued.

- (b) Material only on items
- (c) Labor only on items
- (d) Material and labor on items
- (e) Purchaser will furnish the items as indicated in sections 4-b, c and d, subject to inspection of the Contractor, who shall state any objections thereto before starting his part of the work. After rectification by the Purchaser of any defects reported, the Contractor shall assume full responsibility for the proper functioning of the installation. The intent of this section is to bar any claim by the Contractor that the work done by the Purchaser has not been performed in such manner as to enable him to fulfill all the provisions of the contract.

5. *Alternates.*

- (a) The provisions contained in the alternate requisites section of this specification form a part hereof only when substituted by Purchaser's order for the provisions contained in this specification.

6. *Shipment of material.*

- (a) Material shall be shipped to, care of, marked for Material shipped from Contractor's factory at shall be shipped via and thence via to destination.

7. *Transportation.*

- (a) Purchaser will furnish transportation for men, necessary for the installation, over the following lines (*R-7-a):
 - 1.
 - 2.
- (b) Purchaser will furnish transportation for tools and material, necessary for the installation, over the following lines (*R-7-b):
 - 1.
 - 2.

8. *Inspection of installation.*

- (a) Contractor shall advise the Purchaser days in advance of the time installation will be completed and ready for final inspection. Purchaser will make inspection and tests within days after completion of the work.

* Alterate requisites section.

9. Tests.

(a) Contractor shall make such tests as may be necessary to demonstrate, to the satisfaction of the Purchaser, that the apparatus, as installed, is in accordance with the requirements of the specifications and contract. These tests, unless otherwise specified, shall include the tests shown in section 9-b and shall be conducted in accordance with A.A.R. Signal Section instructions for testing. Contractor shall provide such instruments and apparatus as may be necessary for making tests. Instruments and apparatus shall remain the property of the Contractor.

(b) The following tests shall be made in accordance with A.A.R. Signal Section instructions for testing unless otherwise specified by the Purchaser:

1. General.

(a) Service test shall be made to determine that signals and systems function as intended.

(b) Tests to determine that all circuits conform to approved circuit plans by individually electrically checking each contact selection.

(c) Test of all electrically operated devices to determine that electrical operating characteristics are in accordance with A.A.R. Signal Section specifications.

2. Insulation.

(a) Test of insulation resistance for each complete circuit except battery and common connections to determine that resistance is not less than 1 megohm between conductors and to ground.

3. Switch circuit controllers.

(a) Test to determine that switch circuit controllers are in accordance with Instructions for Switch Circuit Controllers, Manual Part 134.

4. Track circuits.

(a) Test to determine that track circuits have been installed and adjusted in accordance with approved specifications.

5. Voltage.

(a) Tests to determine that voltage for all apparatus is in accordance with Manufacturer's specifications and that voltage applied to lamps is in accordance with specifications furnished by the Purchaser.

10. Completion.

(a) When installation is completed, apparatus and surface of the ground which has been affected by the installation, shall be left in a neat and clean condition.

11. Clearances.

(a) Clearances shall conform to clearance diagram recommended by the A.A.R. *R-11-a.

* Alternate requisites section.

*Detail Provisions*12. *Transformers.*

- (a) Oil-cooled transformer shall be in accordance with Specification 84, Manual Part 165.
- (b) Air-cooled transformer shall be in accordance with Specification 83, Manual Part 164.
- (c)

13. *Rectifiers.*

- (a) Rectifiers shall be of type.
- (b) Rectifiers shall be in accordance with the following specifications, where applicable:
 - 1. Copper-Oxide Rectifiers and Valves—Specification 166, Manual Part 139.
 - 2. Tantalum Rectifiers and Valves—Specification 189, Manual Part 47.
 - 3. Selenium Rectifier—Specification 229, Manual Part 243.
 - 4. Rectifier—Specification, dated
- (c) Track circuit rectifier characteristics.
 - 1. A.C. volts, cycles
 - 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating track circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (d) Line circuit rectifier characteristics.
 - 1. A.C. volts, cycles
 - 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating line circuits direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.
- (e) Signal operating rectifier characteristics.
 - 1. A.C. volts, cycles
 - 2. D.C. volts max., min., amperes max., min., for:
 - (a) Operating signals direct.
 - (b) Charging cells, type storage battery.
 - (c) Use in multiple with cells, ampere-hour type primary battery.

13. *Rectifiers.*—Continued.

- (f) rectifier characteristics.
 - 1. A.C. volts, cycles
 - 2. D.C. volts max., min.
- amperes max., min., for:
 - (a)
 - (b) Charging cells, type
storage battery.
 - (c) Use in multiple with cells,
ampere-hour type primary battery.

14. *Foundations.*

- (a) Foundations shall conform to Drawing
dated
- (b) Foundations shall be so located as to conform to Drawing
dated

15. *Concrete.*

- (a) Concrete shall be in accordance with Purchaser's Specification
dated

16. *Signals.*

- (a) Signals shall conform to Drawing 1462 or 1489.
- (b) Electric light unit for highway crossing signal shall be in accordance with Specification 190, Manual Part 166, or Specification 232, Manual Part 244.
- (c) Electric motor mechanism and gate arms shall be in accordance with Specification 199, Manual Part 194.
- (d) Crossing signals shall be in accordance with Requisites for Highway Grade Crossing Signals, Manual Part 148.
- (e) Automatic gates shall be in accordance with Requisites for Automatic Gates—Highway Crossings at Grade over Railroad Tracks, Manual Part 35.
- (f) "No Right Turn" and "No Left Turn" signals shall be in accordance with Requisites for "No Right Turn" and "No Left Turn" Signals for Highway Crossings at Grade over Railroad Tracks, Manual Part 224.

17. *Controls.*

- (a) Controls shall conform to Requisites for Control of Automatic Highway Grade Crossing Signals and Devices, Manual Part

18. *Wires and cables.*

- (a) Wires and cables shall be in accordance with the following specifications:
 - 1. Copper-Bearing Steel Wire with or without Weather-Resistant Covering—Specification 196, Manual Part 181.
 - 2. Specification for Galvanized Steel Strand, Manual Part 184.

18. *Wires and Cables.*—Continued.

3. Copper-Covered Steel Wire with or without Weather-Resistant Coverings—Specification 167, Manual Part 180.

4. Hard-Drawn Copper Wire with or without Weather-Resistant Covering—Specification 169, Manual Part 182.

5. Single-Conductor, Insulated Wire and Cable with Flame-Retarding, Moisture-Resistant or Weather-Resistant Braid Covering or Outer Polychloroprene Sheath—Specification 111, Manual Part 186. *R-18-a-5.

6. Aerial Aluminum Cable Steel Reinforced—Specification 54, Manual Part 24.

7. Multiple-Conductor, Insulated Cable with Weather-Resistant or Flame-Retarding, Moisture-Resistant Braid Covering—Specification 89, Manual Part 25.

8. Single and Multiple-Conductor, Insulated, Lead Sheathed Cable—Specification 91, Manual Part 28.

9. Single and Multiple-Conductor, Insulated, Lead-Covered Parkway Cable, Armored with Flat Steel or Zinc Tape—Specification 145, Manual Part 20.

10.

11.

19. *Size of Wire.*

(a) Wire shall be of sufficient size to permit operation of signals in accordance with this specification.

(b) Single-conductor wires outside buildings and instrument cases shall be not smaller than No. A.W.G.

(c) Wires and cables shall be not smaller than No. A.W.G.

(d) Line wires shall be not smaller than No. A.W.G. for hard-drawn copper or No. A.W.G. for copper-covered steel.

(e) Common wire shall have conductivity of not less than that of No. A.W.G. hard-drawn copper.

(f) Spare wires shall be provided as follows:

1.

2.

(g) Track circuit wires shall be as follows:

	No. of conductors	A.W.G.	Wire or cable
1. Energy to rail.....			
2. Relay to rail.....			
3. Fouling shunt connections.....			

(h) Connections to rail shall conform to Drawing 1632.

*R-19-h.

* Alternate requisites section.

19. *Size of wire.*—Continued.

- (i) Control wires shall be not smaller than No.
A.W.G.
- (j) Local wiring in buildings and instrument cases shall be not
smaller than No. A.W.G. except it shall have
..... in. thickness of insulation and flame-resisting finish.

20. *Wiring.*

- (a) Wiring shall be in accordance with Specification 119,
Manual Part 84.
- (b) Rubber-insulated tape shall be in accordance with Speci-
fication 56, Manual Part 158.
- (c) Friction tape shall be in accordance with Specification 82,
Manual Part 157.
- (d) All wires shall be marked with tags in accordance with
Purchaser's prescribed practice.

21. *Terminal blocks.*

- (a) Terminal blocks shall conform to Drawing 1054, 1056 or
1077. *R-21-a.

22. *Fuses.*

- (a) Fuses shall be:

	Type	Voltage	Capacity
1.			
2.			

23. *Bonding.*

- (a) Bonds shall be type and bonding installed
in accordance with Specification 135, Manual Part 22. *R-23-a.
- (b) Impedance bonds shall be in accordance with Specification
74, Manual Part 67.

24. *Power.*

- (a) Two sources of power shall be provided for the operation
of each crossing signal. Where commercial power is not available
this provision may be accomplished by the use of two batteries
with multiple connections between the two batteries.

25. *Batteries.*

- (a) Batteries shall be in accordance with the following speci-
fications and drawings:
1. Nickel, Iron, Alkaline Storage Battery—Specification
49, Manual Part 15.
 2. Lead Acid Stationary Storage Battery (Plates of Pure
Lead)—Specification 58, Manual Part 19.
 3. Lead Type Portable Storage Battery for Signaling—
Specification, dated

* Alternate requisites section.

25. Batteries.—Continued.

4. Lead Acid Stationary Storage Battery (Plates of Alloy Composition)—Specification 158, Manual Part 117.
5. Lead Acid Stationary Storage Battery (Plates of Composite Structure)—Specification 53, Manual Part 18.
6. Specification for Electrolyte, Manual Part 13.
7. Type "A" Copper-Oxide Caustic Soda Primary Cell—Specification 87, Manual Part 6.
8. Battery Jar (Primary)—Specification 113, Manual Part 9.
9. Battery Jar (Storage)—Specification, dated
10. Round Jars and Cover—Drawing 1053.
11. Rectangular Jars and Cover—Drawing 1419.
- (b) Jars for caustic soda type of battery shall conform to Drawing, dated
- (c) Track batteries shall be type and ampere-hour capacity.
- (d) Line batteries shall be type and ampere-hour capacity.
- (e) Operating batteries shall be type and ampere-hour capacity.

26. Relays.

- (a) Direct current relays.
 1. Tractive armature direct current neutral relays shall be in accordance with one or more of the following:
 - (a) Specification 105—Tractive Armature Direct Current Neutral Relay with Two or More Contact Fingers, Manual Part 123.
 - (b) Specification 154—Tractive Armature Direct Current Neutral Relay for Series Line Approach Lighting, Manual Part 101.
 - (c) Specification 186—Tractive Armature Direct Current Neutral Interlocking Relay, Manual Part 105.
 - (d) Specification 204—Tractive Armature Direct Current Neutral Relay, Plug-in Type, Manual Part 77.
 - (e) Specification 228—Tractive Armature Direct Current Biased Neutral Relay, Manual Part 232.
 - (f) Track relays shall be of ohms resistance and have not more than nor less than contact fingers.
 - (g) Line relays shall be of ohms resistance and have not more than nor less than contact fingers.
 2. Flasher relay shall be in accordance with Specification 185, Manual Part 143.
 3. Time element relay shall be in accordance with Specification 197, Manual Part 1, or Specification 202, Manual Part 2.

26. *Relays.*—Continued.

4. Other types of direct current relays shall be as follows:
 - (a)
 - (b)
- (b) Alternating current relays.
 1. Relays shall be of the following type:
 - (a)
 - (b)
 2. Alternating current relays shall be in accordance with Specifications 78 and 148, Manual Parts 122 and 53.
 3. Track relays shall operate on and have contact fingers:
 - (a) Single-element volts cycles and not more than nor less than contact fingers.
 - (b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:
 1. Track winding volts cycles.
 2. Local winding volts cycles.
 4. Line relays shall operate on and have contact fingers:
 - (a) Single-element volts cycles and not more than nor less than contact fingers.
 - (b) Two-element relays shall have not more than nor less than contact fingers and shall have windings for operation on:
 1. Line winding volts cycles.
 2. Local winding volts cycles.
 5. Power transfer relays shall be in accordance with Specification 148, Manual Part 53.
 6. Other types of alternating current relays shall be as follows:
 - (a)
 - (b)

27. *Reactors and resistors.*

- (a) Reactors shall be in accordance with Specification 104, Manual Part 121.
- (b) Resistors shall be in accordance with Specification 106, Manual Part 135.

28. *Lightning arresters.*

- (a) Line arresters, type, shall meet A.I.E.E. requirements and shall be installed as shown on circuit drawings.

28. *Lightning arresters.*—Continued.

(b) Low-voltage arresters, type, shall meet the requirements of Specification 52, Manual Part 95 and shall be installed as shown in circuit drawings.

(c) Arrester grounds shall be in accordance with Specification 60, Manual Part 92. Contractor's liability is limited to grounding elements per ground.

29. *Bootlegs.*

(a) Bootlegs shall conform to Drawing, dated

30. *Track circuit connectors.*

(a) Track circuit connectors shall conform to Drawing 1632, *R-30-a.

31. *Line construction.*

(a) Line construction shall be in accordance with Purchaser's prescribed practice.

32. *Conduits.*

(a) Conduits shall be in accordance with A.A.R. Communications Section specification.

33. *Instrument and battery housings.*

(a) Instrument and battery housings shall conform to Drawings, dated

34. *Insulated rail joints.*

(a) Insulated joints shall be type and for section, lb. rail with hole drilling.

(b) Insulated joints shall be installed in accordance with Instructions for Insulated Rail Joints, Manual Part 133.

(c) Insulated joints shall be located as shown on Drawings 1634, 1635, 1636, 1637 and 1638.

35. *Paint and painting.*

(a) Paint and painting shall be in accordance with Requisites for Highway Grade Crossing Signals, Manual Part 148 and Specification 120, Manual Part 110.

36. *Padlocks.*

(a) Purchaser's padlocks shall be furnished by and shall be used where specified.

* Alternate requisites section.

37. *Special items.*

(a)

Alternate requisites.

R-7-a.

Contractor will furnish transportation for men, necessary for the installation, over the following lines:

R-7-b.

Contractor will furnish transportation for tools and material, necessary for the installation, over the following lines:

R-11-a.

Clearances shall conform to clearance diagram, Drawing, dated

R-18-a-5.

Mineral matter rubber compound insulated signal wire shall be in accordance with Specification, dated

R-19-h.

Connections to rail shall conform to Drawing, dated

R-21-a.

Terminal blocks shall be

R-23-a.

Bonding shall be installed in accordance with Specification, dated

R-30-a.

Track circuit connectors shall conform to Drawing, dated

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Specification 209-44—Highway Grade Crossing Automatic Gates,
Manual Part 179.

COMMITTEE IX—OVERHEAD AND UNDERGROUND LINES

Personnel

G. C. Felton, Chairman	
W. W. Beard, Vice-Chairman	
H. H. Cooper	V. O. Smeltzer
R. W. Margsh	R. C. Steele
M. A. Nyberg	E. P. Stephenson
R. H. Smedley	C. L. Summers
W. M. Vogts	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on use of insulation for wire and cable other than materials covered by specifications now in the Manual.
4. Investigate and report on the use of self-supported aerial cables and the use of spinning wire in connection with cables, including cables having plastic jackets.
5. Investigate and report on the various types of coverings for line wires now available.
6. Investigate and report on improved methods of splicing signal line wires, and making terminal and branch connections.
7. Performance specification for solderless type connectors for making line connections (various size conductors).

The Committee submits for consideration, reports on the following subjects*:

1. Revision of Specification 145-48, Manual Part 20.
Revision of Specification 89-48, Manual Part 25.
Revision of Specification 90-48, Manual Part 26.
Revision of Specification 91-48, Manual Part 28.
Revision of Specification 161-48, Manual Part 36.
Revision of Specification 111-48, Manual Part 186.
Revision of Specification 239-48, Manual Part 248.
Revision of Specification 240-48, Manual Part 249.
3. Insulating materials used experimentally or otherwise.
4. Use of self-supported aerial cables and the use of spinning wire in connection with cables, including cables having plastic jackets.
5. Various types of coverings for line wires.
6. Improved methods of splicing signal line wires and making terminal and branch connections.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

Information

Specifications, etc. of other organizations referred to in the report of this Committee may be procured from the following:

A.S.T.M.—American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Disposition of 1949 Letter Ballot Subject

The following subject presented by Committee IX at the 1949 Annual Meeting was submitted to letter ballot and officially approved:

Specification for the Joint Use of Poles for Power, Communication and Signal Circuits on Railroad Property—Now in Manual Part 270.

(Revision of A.A.R. Signal Section Specification 145-48)
A.A.R. SIGNAL SECTION SPECIFICATION 145-50.

SINGLE AND MULTIPLE-CONDUCTOR, INSULATED,
LEAD-COVERED PARKWAY CABLE, ARMORED
WITH FLAT STEEL OR ZINC TAPE

Proposed Revision

6. *Insulation.*

(c) No outer covering shall be provided on individual insulated conductors of cable. *R-6-c.

7. *Assembly.*

(e) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices if necessary to make cable round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices.

Alternate requisites.

R-6-c.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.

2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.

3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 7-e of Specification 145-48—Single and Multiple-Conductor, Insulated, Lead-Covered Parkway Cable, Armored with Flat Steel or Zinc Tape, Manual Part 20.

(Revision of A.A.R. Signal Section Specification 89-48)
A.A.R. SIGNAL SECTION SPECIFICATION 89-50.

MULTIPLE-CONDUCTOR INSULATED CABLE WITH
WEATHER-RESISTANT OR FLAME-RETARDING
MOISTURE-RESISTANT BRAID COVERING

Proposed Revision

6. *Insulation.*

(c) No outer covering shall be provided on individual insulated conductors of cable. *R-6-c.

7. *Assembly.*

(e) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices if necessary to make cable round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices.

Alternate requisites.

R-6-c.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.

2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.

3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Section 7-e of Specification 89-48—Multiple-Conductor Insulated Cable
with Weather-Resistant or Flame-Retarding Moisture-Resistant
Braid Covering, Manual Part 25.

(Revision of A.A.R. Signal Section Specification 90-48)
A.A.R. SIGNAL SECTION SPECIFICATION 90-50.

**MULTIPLE-CONDUCTOR INSULATED SUBMARINE CABLE,
LEAD SHEATHED AND ROUND STEEL ARMORED**

Proposed Revision

6. Insulation.

(c) No outer covering shall be provided on individual insulated conductors of cable. *R-6-c.

7. Assembly.

(d) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices if necessary to make cable round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices.

Alternate requisites.

R-6-c.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.

2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.

3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 7-d of Specification 90-48—Multiple-Conductor Insulated Submarine Cable, Lead Sheathed and Round Steel Armored, Manual Part 26.

(Revision of A.A.R. Signal Section Specification 91-48)
A.A.R. SIGNAL SECTION SPECIFICATION 91-50.

SINGLE AND MULTIPLE-CONDUCTOR INSULATED LEAD SHEATHED CABLE

Proposed Revision

6. *Insulation.*

(c) No outer covering shall be provided on individual insulated conductors of cable. *R-6-c.

7. *Assembly.*

(c) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices if necessary to make cable round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices.

Alternate requisites.

R-6-c.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.

2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.

3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 7-e of Specification 91-48—Single and Multiple-Conductor Insulated Lead Sheathed Cable, Manual Part 28.

(Revision of A.A.R. Signal Section Specification 161-48)
A.A.R. SIGNAL SECTION SPECIFICATION 161-50.

SINGLE AND MULTIPLE-CONDUCTOR, INSULATED,
NON-METALLIC SHEATHED CABLE

Proposed Revision

6. *Insulation.*

(c) No outer covering shall be provided on individual insulated conductors of cable. *R-6-c.

7. *Assembly.*

(c) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices if necessary to make cable assembly round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices and if unvulcanized shall be vulcanized when moisture seal rubber jacket is vulcanized. Outer interstices in assembled conductors may be filled by moisture seal rubber sheath in place of individual rubber fillers.

13. *Identification.*

(a) Multiple-conductor cable shall be identified by a tape under the outer coverings showing the name of the Manufacturer and the year in which the cable was manufactured, this information appearing at intervals of approximately 1 ft.

(b) Single-conductor, cable shall be identified by Manufacturer's code color threads.

Alternate requisites.

R-6-c.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.

2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.

3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Sections 7-c and 13 of Specification 161-48—Single and Multiple-Conductor, Insulated, Non-Metallic Sheathed Cable, Manual Part 36.

(Revision of A.A.R. Signal Section Specification 111-48)
A.A.R. SIGNAL SECTION SPECIFICATION 111-50.

SINGLE-CONDUCTOR INSULATED WIRE AND CABLE
WITH FLAME-RETARDING, MOISTURE-RESISTANT
OR WEATHER-RESISTANT BRAID COVERING OR
OUTER POLYCHLOROPRENE SHEATH

Proposed Revision

Alternate requisites.

R-7-a.

2. Outer covering shall be a polychloroprene compound sheath in accordance with Specification 239, Manual Part 249, bonded to the insulation. Cable tape and Manufacturer's name tape shall not be used between insulation and polychloroprene sheath. Electrical tests on wire covered with outer polychloroprene compound sheath shall be made only on finished wire.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Alternate requisites section R-7-a-2 of Specification 111-48—Single-Conductor
Insulated Wire and Cable with Flame-Retarding, Moisture-Resistant or
Weather-Resistant Braid Covering or Outer Polychloroprene Sheath,
Manual Part 186.

(Revision of A.A.R. Signal Section Specification 239-48)
A.A.R. SIGNAL SECTION SPECIFICATION 239-50.

POLYCHLOROPRENE COMPOUND SHEATH FOR
INSULATED WIRE AND CABLE

Proposed Revision

4. *Performance tests.*

(a) Moisture absorption.

3. Test specimens shall be completely immersed for a period of 48 hours in a tightly covered vessel containing distilled water and the level of the water maintained at least $\frac{1}{2}$ in. above the top of the specimen. The area of the surface immersed shall be taken as the sum of the areas of the outside and inside surfaces and edges of the specimen,

4. *Performance tests.*—Continued.

measured with an accuracy of one part in 100. The water shall be maintained at a temperature of not less than 157 deg. F. or more than 159 deg. F. for the period specified.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter in the Manual.

Subject-matter to be Superseded

Section 4-a-3 of Specification 239-48—Polychloroprene Compound Sheath for Insulated Wire and Cable, Manual Part 248.

(Revision of A.A.R. Signal Section Specification 240-48)
A.A.R. SIGNAL SECTION SPECIFICATION 240-50.

SINGLE AND MULTIPLE-CONDUCTOR, INSULATED,
POLYCHLOROPRENE COMPOUND SHEATHED CABLE*Proposed Revision*6. *Insulation.*

(d) No outer covering shall be provided on individual insulated conductors of cable. *R-6-d.

7. *Assembly.*

(e) Soft or unvulcanized rubber-like fillers with or without reinforcing twine shall be used to fill interstices and if necessary to make cable assembly round. Fillers shall be used for all interstices except those requiring a filler smaller than $\frac{1}{8}$ inch in diameter. Fillers shall be able to shape themselves to completely fill interstices and if unvulcanized shall be vulcanized when polychloroprene compound sheath is vulcanized. Outer interstices in assembled conductors may be filled by polychloroprene compound sheath in place of individual rubber-like fillers.

9. *Identification.*

(a) Multiple-conductor cable shall be identified by a tape under the polychloroprene compound sheath showing the name of the Manufacturer and the year in which the cable was manufactured or like information formed in the sheath. This information is to appear at intervals of approximately 1 ft.

(b) Single-conductor cable shall be identified by Manufacturer's code color threads.

* Alternate requisites section.

Alternate requisites.

R-6-a.

1. Conductors shall be individually insulated with a properly vulcanized rubber compound known as Class AO, 30 per cent Hevea rubber, and shall be in accordance with the composition, chemical, physical and electrical requirements for Class AO, 30 per cent Hevea rubber compound specified in A.S.T.M. Specification D 27-46T, sections pertaining to "Insulation."
2. The thickness of the insulation shall be in accordance with Table 1, as specified by the Purchaser.

R-6-d.

1. Individual insulated conductors shall be covered with a polychloroprene compound sheath in accordance with Specification 239, Manual Part 248.
2. Polychloroprene compound sheath over individual conductors shall be bonded to insulation.
3. When polychloroprene compound sheath is provided over individual conductors, thickness A or D, Table 1 shall be reduced by $\frac{1}{64}$ in.

Action Recommended

Acceptance for submission to letter ballot superseding subject-matter
in the Manual.

Subject-matter to be Superseded

Sections 7-c, 9, and alternate requisites section R-6-a of Specification 240-48—
Single and Multiple-Conductor, Insulated, Polychloroprene Compound
Sheathed Cable, Manual Part 249.

INSULATING MATERIALS USED EXPERIMENTALLY
OR OTHERWISE

A questionnaire (Inquiry SS-87A) was issued July 11, 1949 to Voting Representatives of 149 Member Roads in the Signal Section to ascertain the insulating materials which are not A.A.R. Signal Section specification materials, that have been used experimentally or otherwise. Fifty-six replies were received, 14 of which advised they had nothing to report.

All comments on the type of insulating material used were either "good" or "satisfactory," and in addition, definite interest in new type materials is shown by the fact that, of the 42 reporting, 36 had tried new types in some form or other with satisfactory results.

Action Recommended

Acceptance as information.

USE OF SELF-SUPPORTED AERIAL CABLES AND THE USE OF SPINNING WIRE IN CONNECTION WITH CABLES, INCLUDING CABLES HAVING PLASTIC JACKETS†

For the purpose of developing information on assignment 4, questionnaire (Inquiry SS-88A) dated July 11, 1949, was sent to Voting Representatives of 149 Member Roads in the Signal Section. Replies have been received to date from 53 roads, as follows:

Eight roads reported the installation of approximately 60 miles of self-supported cable with satisfactory results. Approximately 90 per cent of the cable was covered with an asbestos braid and the balance was covered with a polychloroprene jacket. The cables were secured to the messenger with copper, annealed copper-covered steel, or bronze tapes. These installations date from 1948.

Two roads reported the installation of approximately 13 miles of cable attached to the messenger by spinning wire with satisfactory results. All of this cable was the braid-covered type and was secured to the messenger with copper, annealed copper-covered steel, galvanized steel, or stainless steel wire. The installations date from 1946.

Action Recommended

Acceptance as information.

VARIOUS TYPES OF COVERINGS FOR LINE WIRES†

In order to develop information on assignment 5, questionnaire (Inquiry SS-89A) dated July 11, 1949 was sent to Voting Representatives of 149 Member Roads in the Signal Section. Replies have been received to date from 55 roads, as follows:

Twelve roads reported the installation of approximately 5,065 miles of line wire covered with polyethylene. These installations date from 1945, and in the majority of instances are satisfactory, although one railroad reported that longitudinal cracks develop in the covering at point of stress on insulators.

Seven roads reported the installation of approximately 1,225 miles of line wire covered with polychloroprene. These installations date from 1945. One road reported the installation of 757 miles of line wire with this covering in 1949 with unsatisfactory results due to a poor bond between the wire and covering.

Three roads reported the installation of 1,742 miles of line wire covered with Polyvinyl-Chloride. These installations date from 1945 and have been satisfactory.

† Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 361 and 474.

Ten roads reported the installation of 2,738 miles of line wire covered with Vinyl Acetal resin varnish. These installations date from 1947 and approximately 21 per cent of the total installed has not proven satisfactory.

Eleven roads reported the installation of 6,809 miles of line wire of the URC weatherproof type, except a sheath of felted fibrous material is used in place of the one or two inner braids. These installations date from 1945 and have been satisfactory.

Action Recommended

Acceptance as information.

IMPROVED METHODS OF SPLICING SIGNAL LINE WIRES
AND MAKING TERMINAL AND BRANCH CONNECTIONS*

To determine the extent to which improved methods of splicing signal line wires and making branch connections are being used, a questionnaire (Inquiry SS-90A) was issued to Voting Representatives of Member Roads in the Signal Section under date of August 12, 1949.

Thirty-one replies were received, eight of which advised they had nothing to report.

1. Splicing signal line wires.

Twenty-three railroads report the use of compression type splicing sleeves.

2. Making branch connections.

Of the 23 roads reporting, three made no report on branch connections. Five roads report the use of solder in making branch connections, seven roads use solderless type connectors, and eight roads use compression type connections.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 325 and 404.

COMMITTEE X—SIGNALING PRACTICE

Personnel

G. K. Thomas, Chairman

E. N. Fox, Vice-Chairman

J. A. Beoddy

H. G. Morgan

J. J. Corcoran

S. E. Noble

H. B. Garrett

W. G. Salmonson

W. N. Hartman

W. S. Storms

T. W. Hays

C. H. Tillett

S. W. Law

L. C. Walters

J. S. Webb

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Report on noteworthy changes in signal practices.
4. Recommend uniform signal practice in the use of aspects and indications for railway signaling.
5. Recommend methods of controlling signals in single-track automatic block signal territory.
6. Investigate and report on new and improved signal devices and related appliances.
7. Investigate and report on light out protection.
8. Investigate and report as to what practical extent existing facilities and equipment can be used for related services.

The Committee submits for consideration, reports on the following subjects*:

3. Noteworthy changes in signal practices.
6. New and improved signal devices and related appliances.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

NOTEWORTHY CHANGES IN SIGNAL PRACTICES*

Consolidation of remote control for main line interlockings.

During the past year there has been activity in the direction of applying remote control principles to combining the control of large independent interlockings, in multiple-track territory, at a central point; that is, the interlockings on an entire division are being remotely controlled from one strategic point, generally, division headquarters.

To effect this concentration of interlocking function control and indication, conventional coded control features, including coded carrier circuits are used for the communication.

Absence of operators at controlled points requires the application of wayside traffic locking circuit principles between controlled points to provide safety for train movements.

One installation already partially in service is planned to incorporate as many as 15 independent interlockings. The first step now under way calls for consolidating the controls for 6 of these interlockings, 4 of which were recently placed in service. Surveys have also been made for other such interlocking groups, one of which will involve 17 on one division, another of which includes a terminal interlocking.

Action Recommended

Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 364 and 495.

NEW AND IMPROVED SIGNAL DEVICES AND
RELATED APPLIANCES*

It should be understood that this is solely a report to inform the members of the availability of the various devices mentioned therein, and what the manufacturers claim they will do. It is submitted as information—it does not constitute any Signal Section recommendation.

Code line unit.

There has recently been made available a "code line unit" which makes possible the elimination of the usual battery equipment for code line energization.

The code line unit provides the line energy from a commercial alternating current power source by use of a special filtered rectifier arrangement. For stand-by service, in the event of alternating current power outage, a tuned alternator with separate output transformer is used.

The elimination of the independent code line battery conserves space for a given code line installation, and eliminates the need for supervision of line battery charging rates, maintenance and renewal of line battery cells.

This is a development of the Union Switch & Signal Co.

Device for operation of code cab signal equipment in non-code cab signal territory.

In order to permit the operation of standard two, three and four-indication coded cab signal equipped locomotives in two-indication non-code cab signal territory, a device known as an electronic modulator has been developed. By the addition of this device to standard coded cab signal equipment, the code equipment can be made to display a clear cab signal when the locomotive is over steady alternating current track circuits of the proper current level and frequency. The modulator consists essentially of a low-voltage vacuum tube oscillator with a change-over switch on the locomotive to connect the modulator as required.

This device can be used where a railroad is in process of changing from two-indication non-code to code cab signaling. Locomotives to which code cab signaling equipment has been applied may, by the addition of the modulators, operate over either type of track circuits during the period of transition from non-code to code. The small size of the modulator will, in most cases, permit it to be mounted within the existing code cab signal equipment box.

This is a development of the Union Switch & Signal Co.

Wiring harness for electric switch and lock movement.

There has recently been made available a wiring harness to be used in electric switch and lock movements. They can be used on low-voltage direct current movements, and high-voltage direct or alternating current.

Harnesses are not available for certain types of switch movements which may have special wiring for dual selector contacts for special control circuits or for operation through a rectifier.

This is a development of the Union Switch & Signal Co.

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 370 and 496.

Special purpose relay DNL-43.

A new relay known as the DNL-43 has been made available for operating in series with searchlight signal mechanisms to provide a slow pick-up action on the signal mechanism.

The purpose of the slow pick-up action is to eliminate signal failures due to light engines crossing insulating joints at high speed, to provide protection against intermittent shunting and prevent loss of stick relay energization.

The DNL-43 relay consists essentially of a single-point DNL-4 relay combined in a single compact case with a thermal unit that requires approximately 5 seconds to operate. The physical size is $4\frac{1}{2}$ inches wide, 5 inches deep and $4\frac{7}{8}$ inches high.

This is a product of the Union Switch & Signal Co.

Retained-neutral neutral relay DN-26.

A new type of retained-neutral neutral relay, Style DN-26, has been developed to meet the need for a neutral relay that will retain its armature in the energized position when the associated control circuit is pole changed.

The relay saves space and power, eliminates the need for a local power source, and can be used in series or in multiple with other types of relays with little effect upon the retaining characteristics.

This is a development of the Union Switch & Signal Co.

Shelf mountings for a single plug-in relay.

There has recently been made available two shelf mountings designed to accommodate a single plug-in relay and arranged for separate application to the shelf of a relay case or house. These new mountings permit plug-in relays and the conventional shelf mounted apparatus to be mounted side by side in standard relay case and wired from the front in the usual manner. Prior to this development, it was necessary to provide a rear entrance to the housing to gain access to the wiring for the plug-in relays.

Where existing relay cases or houses are too crowded to permit addition of a conventional shelf-mounted relay, these mountings may make it possible to install a plug-in relay, thereby eliminating the need for additional housing facilities.

These mountings are a development of both the Union Switch & Signal Co. and the General Railway Signal Co.

Flasher relay FN-27.

A small size flasher relay has been made available for use in providing way-side flashing signal aspects. Such aspects are in use on many railroads as a means for obtaining additional signal indications.

The relay operates with equal "on" and "off" periods, thus assuring that a very uniform flashing light aspect is obtained.

Temperature compensation is provided which makes the flashing rate independent of variations in ambient temperature from minus 40 to plus 180 degrees Fahrenheit.

The design of the magnetic circuit is such that the rate of flashing is also independent of fluctuations in operating voltage.

The flashing rate can be quickly and accurately adjusted over a wide range, approximately 40 to 60 flashes per minute, to meet individual requirements, without disassembling any part of the magnetic structure.

This is a development of the Union Switch & Signal Co.

Improved car retarder.

An improved electrically operated car retarder, known as the Type E, has been made available, with the retarding pressure furnished by springs, the electric power being utilized only to change the degree of pressure.

The end sections of the retarder are inert, so that the loads are self-contained, thus removing the load from the operating bar and mechanism.

The tapered shoes are cast on the end shoe beam and only two kinds of shoes are required, one for the inside of rail and one for the outside of rail.

The retarder may be applied to various weights of rail, and rail joints may be applied within the retarder limits, if desired. Welding of the rails is not necessary.

Rocker type bearings, with hard surface, are applied for longer life and to minimize the need for lubrication.

Maintenance is simplified: there are fewer parts, the space under the shoe beams is open, making cleaning, snow removal and tamping much easier. Where retarders are butted, the shoes of one retarder may be changed without disturbing the shoes of the adjacent retarder, and without leaving a step between the new shoes and those not replaced.

All bolts for tightening and adjusting are accessible, one adjustment is provided for shoe wear, and an individual adjustment for beam alignment.

The retarder may readily be equipped for track circuits in all or in part of its length.

This is a development of the General Railway Signal Co.

Action Recommended

Acceptance as information.

COMMITTEE XI—ELECTRONICS

Personnel

A. B. Armistead, Chairman

J. I. Kirsch, Vice-Chairman

E. F. Brown

P. B. Burley

T. L. Carlson

J. R. DePriest

L. H. Dyke

H. T. Fleisher

A. J. Hendry

J. M. Hesser

J. E. Hillig

J. M. Hoover

N. J. Morrisson, Jr.

N. A. Peebles

H. H. Seifert

V. O. Smeltzer

T. B. Thompson

A. V. Dasburg*

C. B. Shields*

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Revision of Manual.
2. Indexing signal literature.
3. Investigate and report on the use of electronic controls for railway signaling.
4. Report on electronic measuring apparatus applicable to railway signaling.
5. Principles of vacuum tubes, carrier systems and other electronic systems and devices.
6. Recommended basic design principles for electronic controls for railway signaling systems.
7. Investigate and report on the effects to both signal controls and communication when superimposing centralized traffic control circuits on existing dispatchers or other communication circuits, collaborating with Communications Section, A.A.R.
8. Electronic tubes for use in signal apparatus, recommendation to cover type and designations of tubes to meet various requirements.
9. Investigate and report on the practicability of using frequencies above 30 k.c., for carrier circuits used in centralized traffic control.
10. Investigate and report on the use of electronic switches in lieu of electromagnetic relays.
11. Requisites for electronic devices and associated components for use in railway signaling systems.
12. Instructions for shop and field testing of electronic equipment used in railway signaling.
13. Investigate and report on the limitations of radio for signal usage as differentiated from communication usage.

* Consulting Member.

The Committee submits for consideration, reports on the following subjects*:

4. Electronic measuring apparatus applicable to railway signaling.
9. Use of carrier at frequencies above 30 kilocycles for centralized traffic control purposes.
10. Voice-actuated calling unit.
11. Requisites for Electronic Devices and Associated Components for Use in Railway Signaling Systems.
13. Limitations of radio for signal usage as differentiated from communication usage.

Disposition of 1949 Letter Ballot Subject

The following subject presented by Committee XI at the 1949 Annual Meeting was submitted to letter ballot and officially approved:

Electronic Terms and Symbols Used in Signaling—Now in Manual Part 271.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

VOICE-ACTUATED CALLING UNIT

In the operation of line code control systems, it is often necessary for personnel at wayside stations to speak to the control operator over the telephone. Where these circuits are arranged to permit telephone communication, such messages may be transmitted directly over the code control line wires, thereby reducing the burden on busy telephone dispatching circuits.

The voice-actuated calling unit has been developed to facilitate the use of the code control line for telephone communication. It enables maintainers and train crews to call the operator from any field location merely by speaking in normal tones into a field telephone. This simple procedure rings a bell (or lights a light, if desired) at the control office without the use of magneto ringers or other calling device at the field location. The calling unit acts, in effect, as a monitor on lines used primarily for code control operation and only incidentally for voice communication. It is designed to be unresponsive to control and indication codes, and to transient electrical disturbances, but to signal the operator when voice frequencies appear on the line.

Figure 1 shows the circuit of the calling unit. The code control line is coupled to the left-hand triode of V1 through input transformer T1. Transformer T1, as a result of the capacitive reactance of C6 in series with its primary, and of C5 across its secondary, is tuned for peak response in the frequency region around 800 cycles per second, a range characteristic of speech frequencies. This response is intentionally broadened, however, by the loading effect of R10 in the secondary, to obtain an optimum combination of band width and peaking. The input circuit acts, therefore, as a filter which transmits voice frequencies readily but which discriminates against frequencies outside the voice range.

The left-hand triode in V1 is self-biased through cathode resistor R2 and acts as an amplifier for signals impressed on its grid. However, because of the low value of plate supply voltage, and the high values of plate resistor R1 and cathode resistor R2, a considerable degree of limiting occurs in the output of this triode. The effect of this is to keep the level of the signal input to subsequent circuits from exceeding the limiting level, so that the operation of the device is not disturbed by line surges of considerable magnitude.

The output of the left-hand triode in V1, which appears across its plate load, R1, is coupled to the right-hand grid of V1 through C2. The right-hand triode in V1 operates with fixed bias obtained from voltage divider R3-R4 connected across a portion of the 24-volt battery. Under the conditions of low plate supply voltage and high plate load resistance this bias (approximately 1 volt) is sufficient to hold the right-hand triode at cut-off.

V2 is a thyratron biased by means of potentiometer R9 so that under quiescent conditions it does not fire, that is, does not permit current to flow from plate to cathode. Since the signal bell is in series with the plate supply to V2, it is obvious that the bell does not ring under these conditions.

Special attention should now be paid to the state of C3 under the no-signal conditions. While the right-hand triode of V1 remains cut off, as it does in the absence of signal from the left-hand triode, full B24 positive potential exists at the upper end of R6, and negative N24 potential (less the voltage drop through the lower portion of R9) exists at the upper end of R7. As a result, C3

ITEM	DESCRIPTION
C1	0.05 MFD., 400 VDCW.
C2	0.002 MFD., 500 VDCW.
C3	0.5-0.5 MFD., 600 VDCW.
C4	0.5-0.5 MFD., 600 VDCW.
C5	0.005 MFD., 600 VDCW.
C6	0.1 MFD., 600 VDCW.
R1	470,000 OHMS, 1/2 WATT
R2	68,000 OHMS, 1/2 WATT
R3	10,000 OHMS, 1/2 WATT
R4	15,000 OHMS, 1/2 WATT
R5	1 MEGOHM, 1/2 WATT
R6	100,000 OHMS, 1/2 WATT
R7	47,000 OHMS, 1/2 WATT
R8	10,000 OHMS, 1/2 WATT
R9	5,000 OHMS, 2 WATTS
R10	18,000 OHMS, 1/2 WATT
T1	INPUT TRANSFORMER
V1	TWIN TRIODE, TYPE 6F8G
V2	THYRATRON, TYPE 2050
V3	BALLAST, TYPE 6-11B

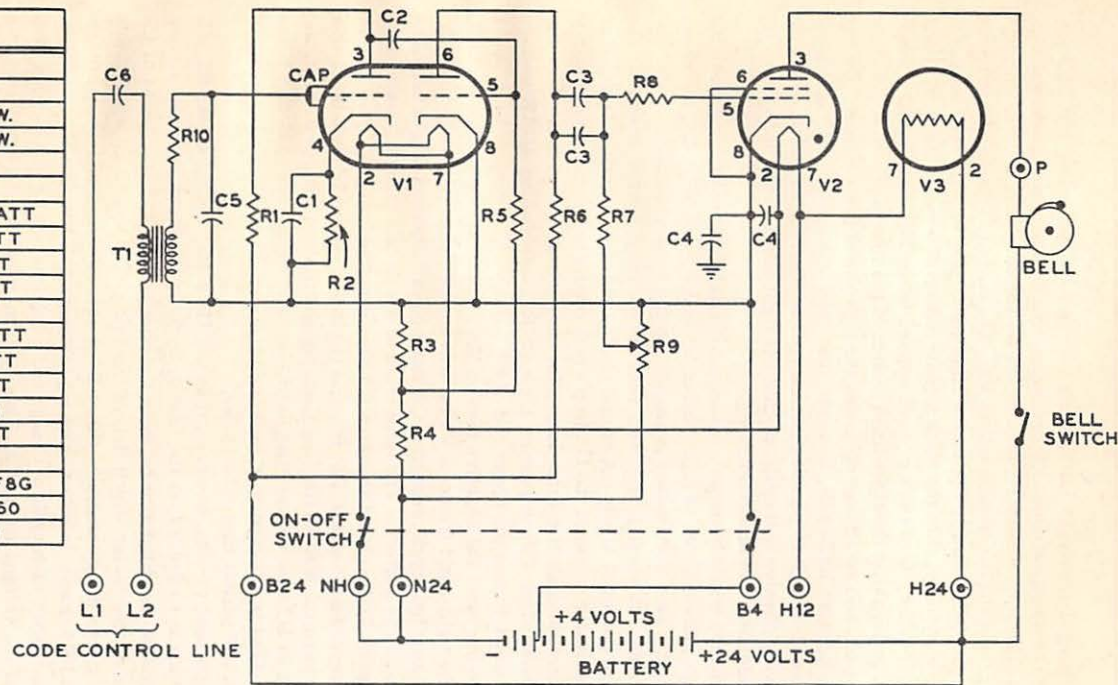


Fig: 1.
Voice-Actuated Calling Unit With Bell Signal.

becomes charged nearly to full battery voltage, or approximately 22 volts. As long as the no-signal condition continues, this charge remains undisturbed.

When a speech-frequency signal appears on the line, it is coupled through T1 to the grid of the left-hand triode in V1. The output of the left-hand triode is in turn coupled, through C2, to the right-hand grid in V1. Assuming, for the sake of simplicity, that the voice signal consists of a single frequency, and that the first half-cycle of the a.c. wave applied to the right-hand grid is negative, it will be seen that the right-hand section of the tube is driven still further beyond cut-off, and no change occurs in the right-hand plate circuit. On the succeeding positive half-cycle, however, the grid voltage on the right-hand triode is raised enough to permit plate current to flow. This action recurs on each following positive half-cycle, so that the right-hand triode becomes alternately conducting and non-conducting.

Each time the triode becomes conducting, it establishes a discharge path for C3, through plate-cathode of right half of V1 and R9 and R7. C3, therefore, discharges at a rate determined primarily by the total resistance of the discharge circuit. It should be noted that the battery cannot maintain the original B24 potential at the upper end of R6, and thus maintain the charge on the capacitor, because of the IR drop which occurs in R6 as soon as battery current flows through the tube during its conducting half-cycles. The discharge current from C3, in passing through R7, establishing an IR voltage difference which makes the upper end of R7 negative with respect to its lower end, and so increases the negative bias on V2. V2, therefore, remains cut off.

When the right-hand triode of V1 returns to the non-conducting condition during the next half-cycle, capacitor C3, having partially discharged, begins to recharge from the battery. The initial rate at which this charging takes place depends upon (1) the extent to which C3 has discharged; (2) the resistance in the charging circuit: namely, R6, R7, and the lower portion of R9. Since this current flows through R7 in the direction opposite to the discharge current, the IR voltage in R7 now opposes the fixed bias, and makes the grid of V2 less negative. That is, the capacitor, in charging, drives the grid of V2 in the direction which will permit that tube to fire.

It is important to note, however, that the IR voltage surge across R7 will not be sufficient to fire V2 on the first cycle from the incoming voice signal. This is because the difference between the charge and discharge paths of C3 establishes a time factor which delays the firing of V2 until an appreciable number of cycles have occurred. Since C3 is able to discharge faster through V1, R9 and R7 than it is able to recharge through R6, R9, and R7 (a path of higher resistance), each cycle of charge and discharge results in a step-by-step lowering of the voltage across C3. This, in turn, produces a step-by-step rise in the value of the initial charging-current surge through R7. Finally, after an appreciable number of cycles, the charging-current surge becomes great enough so that the associated IR voltage pulse in R7 offsets the fixed bias on V2, V2 fires, and the calling bell rings.

The effect of the frequency-selective input circuits, of the limiting action in the left-hand section of V1, and of the time lag in the actuation of the thyatron tube, is to prevent unwanted operation of the bell by random electrical disturbances on the line, or by the relatively slow pulses associated with control and indication codes, while at the same time providing prompt response to speech-frequency signals.

The bell circuit shown in Fig. 1 will ring during any intervals in which speech signals appear on the line. The bell switch would be opened by the dispatcher when he responded to the call to eliminate ringing during the conversation. An alternative arrangement, not shown, leaves the bell permanently connected in the output of the unit, and provides transfer switching of the line from the calling unit to the dispatcher's telephone set. This silences the bell by removing the signal input from the unit.

Since the thyatron tube, V2, once fired, remains conducting until the plate supply is interrupted, the unit can be used to provide a calling signal which will continue to operate until acknowledged, although the original voice signal is no longer on the line. This may be done with the bell signal by shunting the bell terminals with a relatively high-valued resistor to maintain voltage on the plate of V2 during the time the armature contacts are open on the bell. If a call-light signal is used, the continuing indication is automatically provided, since there is no interruption of the voltage supply to the plate of V2. With either type of continuing signal it is necessary to provide a switch in the calling-signal circuit to permit interruption of the current flow in V2, thereby resetting the unit for response to a new speech signal.

The only source of energy required for the voice-actuated calling unit is, as shown in Fig. 1, a 24-volt battery. No auxiliary high-voltage supplies are needed. Usually, however, tube heaters are energized from a 12-volt a.c. source through the H12 terminal, and a power transfer relay is used to switch the unit to full battery operation in the event of a.c. power failure.

The calling unit is built on a metal chassis, and is protected by a perforated metal cover. An on-off switch is provided, and a sensitivity control knob is mounted on the front panel for convenient adjustment of R9. Over-all dimensions are approximately 5½ by 10 by 8 inches.

A number of the calling units have been in use for several years, and have provided satisfactory service.

Action Recommended

Acceptance as information.

A.A.R. SIGNAL SECTION REQUISITES.

ELECTRONIC DEVICES AND ASSOCIATED COMPONENTS
FOR USE IN RAILWAY SIGNALING SYSTEMS

1950

1. *General.*

- (a) The units shall be fabricated from high quality components.
- (b) Electronic devices shall withstand the effects of vibration, shock, temperature changes, and other severe operating conditions to be expected in railway signaling.
- (c) Chassis and cabinets shall be so designed that chassis assembly can be readily replaced.
- (d) Adequate shielding of components and associated leads shall be provided.
- (e) All circuit alignment and other adjusting points shall be readily accessible in order to facilitate servicing operations.
- (f) Adjusting points shall be sealed or locked except those used for routine field maintenance.
- (g) Power supply units shall be provided with suitable filters.
- (h) Adequate temperature control to insure proper operation of electronic components shall be provided when necessary.
- (i) Electrical apparatus subject to surges from exposed lines shall withstand for one minute an insulation test of 3,000 volts a.c. between all parts of such electric circuits and other metallic parts insulated therefrom.
- (j) All component parts shall be so arranged and mounted as to be easily accessible and replaceable without appreciable disturbance to other parts of the unit.
- (k) All components shall be fastened to the chassis by machine screws and nuts secured by suitable means which shall prevent loosening under vibration. Rivets or self-tapping screws shall not be employed.

2. *Capacitors.*

- (a) Capacitors used in this equipment shall be capable of complying with the following Joint Army-Navy Specifications where applicable:
 - 1. Mica-dielectric Capacitors.....JAN C-5, as amended.
 - 2. Dry-electrolytic Capacitors.....JAN C-62, as amended.
 - 3. Paper-dielectric Capacitors.....JAN C-25, as amended.
- (b) No capacitors shall be subjected to voltages in excess of their rating under any conditions encountered in starting and operating the equipment.
- (c) Use of electrolytic capacitors should be avoided wherever possible.

3. Resistors.

(a) Resistors shall be capable of complying with the following Joint Army-Navy Specifications where applicable:

1. Composition Resistors.....JAN R-11, as amended.
2. Wire-wound Resistors.....JAN R-26, as amended.

4. Transformers and reactors (low frequency).

(a) All low-frequency reactors and transformers, both for audio and power circuits, shall be thoroughly vacuum impregnated with a high-quality insulating varnish or other suitable insulating compound.

(b) Terminals shall be used when practicable and shall be permanently and legibly marked to permit identification on the schematic wiring diagram.

(c) Terminal boards, if used, shall be of non-hygroscopic insulation of such nature that under any specified service condition, or in the process of soldering the terminals, said terminals will not become loosened nor the insulation material be injured.

5. Tube sockets.

(a) Tube sockets for the power supply may be of the molded-phenolic type provided they meet R.M.A. Standards for sockets.

(b) Similar sockets may be used in other units where equivalent performance requirements to that obtainable with ceramic insulated sockets can be realized.

(c) In circuits where improved performance can be obtained by its use, glazed ceramic insulation shall be employed for tube sockets.

(d) The proper tube designation shall be marked adjacent to each socket.

(e) All tube sockets shall be rigidly mounted so that the entire periphery of each socket rests on the chassis.

(f) The use of small angle brackets or similar means for supporting sockets only at their mounting holes, will not be permitted.

6. Tubes.

(a) All tubes shall be of best available types for the service required and shall be operated within the tube Manufacturer's published ratings.

(b) Tubes of the glass envelope type shall be protected from injury by suitable metal enclosure, where required to prevent excessive breakage.

(c) Tubes shall be mounted in position as specified by Manufacturer.

7. Chassis, front panels, and mounting details.

(a) Chassis, front panels, and mounting details may be either aluminum steel or equivalent.

(b) If steel is used, it is required that all parts be given corrosion-resisting treatment after all machining operations have been completed.

(c) If aluminum is used for the panels, it is required that the front surface be etched prior to finishing.

(d) Adequate rigidity shall be provided to prevent undue distortion.

8. *Small part mountings.*

(a) Small resistors, capacitors, and other items designed to be supported by their leads may have their leads soldered directly to the points in the circuit which they are to connect provided short lead lengths are required for optimum circuit performance and for such mounts the leads shall be as short as possible, otherwise these items shall be mounted by their leads on suitable terminal strips or panels, the leads being soldered to the eyelets or terminals in the manner which will provide maximum rigidity of support.

(b) If resistors having ferrule type connections are employed, they shall be mounted in clips equal to those of the positive pressure type.

(c) Resistors having lug terminals shall be firmly mounted in such a manner as to prevent rotation without relying upon the lugs for support, but shall be easily replaceable in case of failure.

9. *Wiring.*

(a) All wiring shall be cabled, when practicable, and clamped to the chassis.

(b) Wiring shall be color-coded or otherwise marked to differentiate between types of circuits such as plate, grid, power circuits, etc.

(c) Where insulated leads pass through holes in the chassis, the holes shall be equipped with smoothly finished grommets.

(d) Only non-corrosive soldering flux shall be used.

(e) All wires connected to terminals which require soldering shall be securely fastened to the terminals by crimping the terminals firmly on the wire or the wire on the terminals before soldering, and shall not depend on solder for mechanical strength.

(f) In no case shall any insulating materials be subjected to the pressure required to make good electrical connections.

(g) No electrical connections shall be made by clamping wires smaller than No. 18 A.W.G. between metal parts.

(h) Wherever a wire is connected to an unthreaded stud, the stud shall be grooved or have a hole drilled through it and wire rounded into the groove or placed through the hole and twisted around the stud before soldering.

(i) All wire shall be suitable for continuous operation at 185 deg. F.

(j) The minimum size of insulated conductor shall be No. 22 A.W.G.

(k) The voltage rating of all insulated wire shall be at least 50 per cent greater than the peak voltage to ground impressed on the conductor in normal operation and shall in no case be less than 500 volts.

10. *Accessibility of parts.*

(a) All circuit components shall be so mounted in the chassis assemblies as to permit their replacement without appreciable disturbance to other components.

(b) All switches and controls shall be mounted in such a manner as to permit their convenient replacement without removal of other units.

11. Hardware.

(a) All steel bolts, studs, screws, nuts, etc., used in the equipment shall be nickel plated, or otherwise suitably protected against corrosion, and shall be in accordance with Specification for Bolts, Nuts and Threads, Manual Part 17.

(b) A minimum of two threads in use in all materials is required.

Action Recommended

Acceptance for submission to letter ballot.

LIMITATIONS OF RADIO FOR SIGNAL USAGE AS DIFFERENTIATED FROM COMMUNICATION USAGE

The limitations of radio for signal as compared with communication use can be considered using two applications of radio:

1. Utilizing space as transmission medium.
2. Utilizing wire or cable as transmission medium commonly known as carrier system.

In general, radio for signal usage would be feasible only where numerous control functions are concentrated, such as the remote control of a group of switches and signals. The complete local signal controls, switch check and route selections are usually too scattered to warrant consideration of radio control. Confining radio to the remote control and indication application would keep it in the non-vital circuit field with all vital or safety circuits at the field layout. Complete standby equipment would generally be required to minimize delays due to tube failures, etc.

With space radio, the terrain may present a considerable problem.

With space radio, the problem of obtaining and training maintainers would be complicated by the fact that any transmitter adjustments would have to be made by F.C.C. licensed men.

For space radio, the allocation of frequencies would be under F.C.C. regulation. Allocation of non-interfering channels would be more complicated in congested railroad territory, such as large terminals.

Radio control of signals by applying carrier to a pair of wires or cable appears to be the more practical method. This would be especially true if the same wire or cable were also used for all other railroad requirements, such as telephone, telegraph and printers. In this type of control, signaling has an advantage over voice communication in that it would require only a very narrow frequency band; whereas communication requires a relatively wide band to be intelligible.

The carrier system can be utilized to its best advantage when sufficient controls are required to make it expedient to supply a fundamental carrier and modulate it with various frequencies to provide the additional controls.

If radio were used for vital circuits, the design would have to be on a "fail safe" basis.

Action Recommended

Acceptance as information.

ELECTRONIC MEASURING APPARATUS APPLICABLE
TO RAILWAY SIGNALING*

Frequencies Above 10 Kilocycles

1. *The analyzer type of instrument having suitable volt, ampere, and resistance scales.*

Typical of this type of instrument is the Weston—Model 785, industrial current tester. Instruments similar to this with slight differences can be obtained from other reliable instrument companies.

The instrument should have a sensitivity of not less than 20,000 ohms per volt d.c. and 1,000 ohms per volt a.c. A.c. volt range—0-750 volts with full scale readings of 5-15-30-150-300-750 volts. A.C. current range—0-10 amperes with full scale readings of 0.5-1-5-10 amperes. Resistance in ohms with scale—0 to 3,000 ohms with multipliers of 10-100-1,000 and 10,000. D.C. volts—0-1,000 volt range with full scale reading 200 milli-volts, 1-10-50-200-500-1,000 volts. D.C. current—0-10 amperes range with full scale readings—50 micro-amperes, 1-10-100 milliamperes, 1-10 amperes.

An instrument of the analyzer type is probably the most versatile instrument available for shop and field testing of electronic equipment encountered in railway signaling and can be used to make practically all measurements of current, voltage, and resistance necessary in railway signal electronics equipment operating under 20 kilocycles.

2. *Vacuum tube voltmeter.*

The vacuum tube voltmeter must be utilized for making measurements in high frequency circuits, and circuits in which the application of a standard meter will load the circuit thereby causing an error in reading. Many instruments of this type are equipped with high frequency probe which can be used for tracing high frequency circuits without materially affecting the circuit. A typical instrument of this type is the Hickock—Model 125.

3. *Cathode-ray oscilloscope.*

The oscilloscope can be utilized for adjusting oscillator frequencies by comparison with a known frequency standard, also for study of wave forms, transient currents, etc. The uses of this instrument are so varied it is impracticable to list them. Literature on their use can be readily obtained.

4. *Signal generators.*

The signal generator has utility as a source of high frequency current for test purposes. These instruments can be obtained in a wide range of frequencies with calibrated dial for selecting any frequency within its range. In selecting a signal generator for railway signaling electronics, consideration should be given to frequency range of equipment in service.

Action Recommended
Acceptance as information.

* Previous report on this subject appears in A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 355 and 395.

USE OF CARRIER AT FREQUENCIES ABOVE 30 KILOCYCLES
FOR CENTRALIZED TRAFFIC CONTROL PURPOSES

The installation on the St. Louis-San Francisco Ry. described in the 1948 Annual Meeting Advance Notice* has been modified to correct inefficiencies of transmission at the higher frequencies. Specifically, it was necessary to alter the control frequency between Springfield and Lebanon, Mo., from 56.4 kilocycles to 29.7 kilocycles, and the control frequency between Springfield and Newburg, Mo., from 51.1 kilocycles to 25.0 kilocycles. These changes were made as the result of excessive attenuation at these frequencies during heavy icing conditions.

Action Recommended



Acceptance as information.

* A.A.R. Signal Section 1947 Proceedings, Vol. XLV, pp. 354 and 395.

COMMITTEE XII—CIRCUIT DESIGN

Personnel

W. W. Welsh, Chairman
H. A. Scott, Jr., Vice-Chairman

R. A. Bishop	H. L. Kruke
B. E. Brooksby	J. H. Molloy
T. L. Carlson	E. Pitt
W. H. Claus	L. B. Sinclair
B. R. Dellinger	D. H. Steiner
O. C. French	C. L. Steinmetz
A. N. Goodson	R. E. Testerman
H. A. Haines	W. M. Whitehurst
H. L. Hinton	F. Youngwerth
E. W. Horning	A. Langdon*
H. A. Thompson*	

Signal Section, A.A.R.:

The following outline of work has been assigned:

1. Indexing signal literature.
2. Prepare typical circuits representing current practice for railway signaling, as follows:
 - (a) Automatic block signals.
 1. For track equipped for operation in one direction only.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits with and without use of line wires.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 2. For track equipped for operation in both directions.
 - (a) Color light type signals, conventional d.c. track circuits.
 - (b) Searchlight type signals, conventional d.c. track circuits.
 - (c) Coded track circuits.
 - (d) Electric switch locking.
 - (e) Spring switch protection.
 - (f) Approach and advance lighting.
 - (g) Light out protection.
 - (b) Interlocking.
 1. Relay type interlocking, unit and route types.
 - (a) Route-check network (lever-agreement relays).
 - (b) Signal control network.
 1. Color light type signals.
 2. Searchlight type signals.

* Consulting Member.

Sept. 1950]

- (b) Interlocking.—Continued.
 - (c) Signal indication.
 - (d) Time locking.
 - (e) Approach locking.
 - (f) Route locking.
 - (g) Switch locking.
 - (h) Switch control.
 - (i) Switch indication.
 - (j) Power distribution.
 - (k) Model board indications.
 - (l) Remote control circuits.
 - (m) Electric locking of hand-operated switches within interlocking limits.
 - (n) Traffic locking.
 - (o) Drawbridge protection.
- (c) Highway crossing signal protection.
 - 1. Control arrangement.
 - (a) Selective speed controls.
 - (b) Interconnection with street traffic signal devices.
 - 2. Types of protection.
 - (a) Flashing lights.
 - (b) Automatic and semi-automatic gates.
- (d) Wayside typical circuits for train stop, train control, and cab signals.
 - 1. Continuous.
 - 2. Intermittent.
- (e) Miscellaneous.
 - 1. Power and color light train order signals.

The Committee submits for consideration, reports on the following subjects*:

- 2. A.A.R. Sig. Sec. 8025A, 8027A, 8028A, 8030A, 8031A, 8043A to 8054A, inclusive.

* Suggestions or criticisms should be submitted in writing to the Chairman of the Committee on or before August 21, 1950.

TYPICAL CIRCUITS REPRESENTING CURRENT PRACTICE
FOR RAILWAY SIGNALING*

The Committee presents 30 typical plans covering its assignments for relay interlocking, unit and route types, remote control, automatic signals, coded track circuits, electric switch locks, spring switches, cab signaling, automatic highway crossing signals and train order signals.

In addition, sheets 1 and 2 of A.A.R. Sig. Sec. 8028A, issued in 1948, are revised as covered by Note 6.

The titles and accompanying notes are designed to make the various circuits self-explanatory as far as possible. Each represents current practice on one or more Member Roads.

Your attention is again directed to the fact that these typicals are not working drawings. Anyone using any of the principles illustrated should be careful to take into account the type of equipment to be used and local conditions.

The plans presented are:

A.A.R. SIG. SEC.

- 8025A—(Sheets 1 to 6, incl.)—Typical relay type interlocking circuits—route type. Line of light indication for occupancy of detector circuits. (Assignment 2-b-1)
- 8027A—(Sheet 5)—Typical three-aspect color light automatic signal circuits, staggered locations, track signaled in both directions. (Assignment 2-a-2-a)
- 8027A—(Sheet 6)—Typical three-aspect searchlight automatic signal circuits, staggered locations, track signaled in both directions. (Assignment 2-a-2-b)
- 8028A—(Sheets 1 and 2)—Typical circuits for automatic interlocking, revised September 1950. (Note 6 added, circuit revised accordingly, and other minor changes made.)
- 8030A—(Sheets 1 and 2)—Typical remote control switch and signal circuits. Direct wire control. Scheme 1—operator must wait until switch operates before operating signal lever. (Assignment 2-b-1-1)
- 8031A—(Sheets 1 and 2)—Typical remote control switch and signal circuits. Direct wire control. Scheme 2—does not require operator to wait until switch operates before operating signal lever. (Assignment 2-b-1-1)
- 8043A—(Sheets 1 to 4, incl.)—Typical relay type interlocking, circuits permit operation of switch and signal levers simultaneously. (Assignment 2-b-1)
- 8044A—Typical three-aspect color light automatic signal circuits. Tracks signaled in both directions, signals opposite, 2 wire HD control. (Assignment 2-a-2-a)
- 8045A—Typical three-aspect searchlight automatic signal circuits. Track signaled in both directions, searchlight signals opposite and staggered, 2 wire control. (Assignment 2-a-2-b)
- 8046A—Lighting circuits for signals on A.A.R. Sig. Sec. 8044A and 8045A. (Assignments 2-a-2-a, b and f)

* Previous report on this subject appears in A.A.R. Signal Section 1948 Proceedings, Vol. XLVI, pp. 439 and 502.

A.A.R. SIG. SEC.

- 8047A—(Sheets 1 to 4, incl.)—Typical coded track circuits, searchlight signals, rectified a.c. operation, track signaled in one direction. (Assignment 2-a-1-c)
- 8048A—Typical electric switch lock circuits. (Assignment 2-a-2-d)
- 8049A—Typical circuits for spring switch at end of siding, signals semi-automatic. (Assignment 2-a-1-e)
- 8050A—Typical circuits for spring switch at end of siding. Signals approach cleared. (Assignment 2-a-1-e)
- 8051A—Typical circuits to superimpose four indication coded cab signal controls on d.c. track circuits at interlocking. (Assignment 2-d-1)
- 8052A—Typical circuits for selective speed control of automatic highway crossing signals. (Assignment 2-c-1-a)
- 8053A—Typical circuits for automatic highway crossing gates. (Assignment 2-c-2-b)
- 8054A—Typical circuits for electric semaphore color light type train order signals. (Assignment 2-e-1)

Action Recommended

Acceptance as information.

RULES OF ORDER

Effective April 6, 1938

Revised: December 6, 1938; May 22, 1940; March 12, 1941; May 17, 1944;
December 11, 1946; June 8, 1949.

1. **REPRESENTATIVES:** The representatives of Member Roads in the Signal Section shall be employees engaged in an official or supervisory capacity in the design, construction or maintenance of railroad signaling devices. Included within this category shall be Signal Superintendents, Signal Engineers and their Assistants, Signal Inspectors, Chief Draftsmen, Signal Supervisors and Assistant Signal Supervisors, or others with corresponding duties.
2. **AFFILIATED MEMBERS:**
 - (a) **RAILROAD AFFILIATED MEMBERS:** A member of a State or Federal regulatory body, or a railroad employee not embraced within the provisions of paragraph 1 (including those temporarily relieved from service or furloughed) may become a **RAILROAD AFFILIATED MEMBER** upon approval of his application by the Committee of Direction. Such a member will pay an annual fee of \$3.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (b) **AFFILIATED MEMBERS:** A representative of an organization or an individual engaged in the design, manufacture, sale or construction of signal devices or materials applicable thereto, or one who is qualified by his business relations and practical experience to cooperate with the Section, may become an **AFFILIATED MEMBER** thereof upon approval of his application by the Committee of Direction. An Affiliated Member will pay an annual fee of \$6.00 (which may be changed from year to year at the discretion of the Committee of Direction), on January 1st of each year, for which he will receive currently the Advance Notices and Minutes of the Section.
 - (c) A Railroad Affiliated or an Affiliated Member shall have the rights and privileges accorded a Member Road representative except voting or the holding of office.
 - (d) A Railroad Affiliated or an Affiliated Member may be appointed as a Consulting Member of any Standing Committee upon the approval of the Committee of Direction.
3. **LIFE MEMBERS:** Life membership may be conferred upon members who retire from active work. They shall have been active in the affairs of the Signal Section and its predecessors and their total term of membership shall have been not less than twenty-five years. Their rights and privileges shall be continued without change. A proposal to confer Life Membership must be signed by five voting representatives of Member Roads and five representatives of Member Roads, stating

their reason for making such proposal. Proposal shall be duly considered at a meeting of the Committee of Direction and then submitted to a vote by letter to the Committee of Direction membership for approval.

Officers and Committees

4. The Officers of the Section shall consist of a Chairman, First Vice-Chairman, Second Vice-Chairman, and Secretary.
 - (a) The Chairman and Vice-Chairmen shall be selected by the Committee of Direction on or before November 1st. Their terms of office shall be one year from January 1st or until their successors are selected and qualified. A Chairman or Vice-Chairman having served a full term shall not succeed himself.
 - (b) The Secretary will be appointed by the Committee of Direction. His salary shall be named by that Committee subject to the approval of the Vice-President, Operations and Maintenance Department of the Association.
 - (c) The COMMITTEE OF DIRECTION will consist of twelve members, as follows: The Chairman, the First Vice-Chairman, the Second Vice-Chairman, the latest Past Chairman, one member from New England or Canada, three members from the East, one member from the South and three members from the West.

The territorial representatives, except when filling vacancies, shall serve four years and their term of office will expire on December 31st of the fourth year.

Vacancies in official positions or of territorial representatives shall be filled until the next election, by the Committee of Direction.

One Vice-Chairman shall be selected from Eastern Territory and one from Western Territory. For this purpose the Eastern Territory will consist of all territory operating under Eastern and Atlantic Standard Time. All other territory will be known as Western Territory. The location of the official's headquarters will determine whether he is in the Eastern or Western territory.

- (d) The Standing Committees of the Section will be as follows:
 - I—Economics of Railway Signaling
 - II—Interlocking
 - III—Signal Shop Practice
 - IV—Automatic Block Signaling
 - V—Contracts and Instructions
 - VI—Designs
 - VII—Materials Research
 - VIII—Highway Grade Crossing Protection
 - IX—Overhead and Underground Lines
 - X—Signaling Practice
 - XI—Electronics
 - XII—Circuit Design

The representation of Member Roads on these committees will be, when practicable, territorially selected, in approximately the same proportion as that of the Committee of Direction, the personnel to be named each year by the Committee of Direction.

Duties of Officers

5. The CHAIRMAN shall have general supervision over the affairs of the Section and shall preside at meetings of the Section and at meetings of the Committee of Direction.
6. The FIRST VICE-CHAIRMAN, in the absence of the Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
7. The SECOND VICE-CHAIRMAN, in the absence of both the Chairman and First Vice-Chairman, shall perform the duties of the Chairman. He shall perform such other duties as may be assigned to him by the Chairman.
8. (a) The SECRETARY shall devote his entire time to the work of the Section and will perform the usual duties of that office and such other duties as may be assigned to him by the Chairman.
(b) He shall receive on or before November 20th of each year the report of the Committee on Nominations, as elsewhere provided for, and will submit to the voting representatives of Member Roads, not later than November 29th, for letter ballot vote, the nominations contained in that report, to fill the vacancies in the membership of the Committee of Direction. He shall appoint three Tellers from representatives of Member Roads to assist him in counting the ballots, who shall certify the count thereof, with him, to the Committee of Direction. He shall announce the result of the ballot to the Members promptly.
(c) He shall furnish, free of charge, to each representative of a Member Road, designated by such road, one copy of all circulars, Advance Notices and Minutes.
(d) He shall furnish to each Railroad Affiliated, Affiliated and Life Member one copy of all circulars, Advance Notices and Minutes.

Duties of Committees

9. The COMMITTEE OF DIRECTION shall:
 - (a) Exercise general supervision over the interests and affairs of the Section.
 - (b) Be empowered to act on behalf of the Section in the interim between meetings and submit at each meeting a report covering its actions.
 - (c) Examine and decide what portion of communications, papers and reports shall be submitted to the meetings. It shall determine which, if any, of the subjects presented by the various committees shall be referred to the General Committee of the Engineering Division.
 - (d) Appoint on or before October 1st of each year a Committee on Nominations consisting of representatives of five Member Roads, who shall not be members of the Committee of Direction.
 - (e) Appoint additional committees as required.

- (f) Submit to the Vice-President, Operations and Maintenance Department, detail of contemplated financial requirements for conducting the work of the Section as required or as called for by that official.
- (g) Call Annual meetings of the Section if in its judgment conditions warrant.
- (h) Call meetings of the Section upon not less than thirty days' notice to each member. It **MUST** call a special meeting of the Section upon the request in writing of a majority of the voting members of Member Roads.
- (i) Publish Manual of Recommended Practice, in which shall be included such approved Specifications, Drawings, Findings and Conclusions of the Section as the Committee of Direction may find advisable.

10. The COMMITTEE ON NOMINATIONS, appointed as prescribed above, shall report to the Secretary on or before November 20th each year at least two nominations for each impending vacancy to replace the territorial representatives on the Committee of Direction.

The duties of the Standing Committees shall be as follows:

- 11. COMMITTEE I—ECONOMICS OF RAILWAY SIGNALING. Study and report on the economy, if any, of the various signal systems, interlocking, train control, cab signals and other signaling projects.
- 12. COMMITTEE II—INTERLOCKING. Prepare specifications for the various types of interlockings and submit reports on subject-matters relating thereto.
- 13. COMMITTEE III—SIGNAL SHOP PRACTICE. Study and report on signal shop practices.
- 14. COMMITTEE IV—AUTOMATIC BLOCK SIGNALING. Prepare specifications for the various types of automatic block systems and submit reports on subject-matters relating thereto.
- 15. COMMITTEE V—CONTRACTS AND INSTRUCTIONS. Prepare recommended forms for use in connection with signaling contracts and prepare instructions relating to signal maintenance.
- 16. COMMITTEE VI—DESIGNS. Prepare detailed drawings for standardization purposes and make any special study or investigation assigned to it by the Committee of Direction.
- 17. COMMITTEE VII—MATERIALS RESEARCH. Make such investigation of materials used in connection with signaling as directed by the Committee of Direction and submit reports on its conclusions.
- 18. COMMITTEE VIII—HIGHWAY GRADE CROSSING PROTECTION. Prepare requisites for highway grade crossing protection and submit matters of interest relating thereto.
- 19. COMMITTEE IX—OVERHEAD AND UNDERGROUND LINES. Prepare specifications for overhead and underground lines and any recommendations relating to such lines which will be of interest to the Section.

Sept. 1950]

Rules of Order

20. **COMMITTEE X—SIGNALING PRACTICE.** Prepare requisites for the various types of interlocking and block signaling systems, make recommendations having reference to the signal indications which should be given as the varied conditions on railroads require, also submit reports on such other matters as may be assigned by the Committee of Direction.
21. **COMMITTEE XI—ELECTRONICS.** Investigate and report on the use of electronics in connection with railway signal systems, interlocking, centralized traffic control, and highway grade crossing protection.
22. **COMMITTEE XII—CIRCUIT DESIGN.** Prepare typical circuits representative of approved practices and requisites for railroad signaling.
23. **REPRESENTATION OF THE SECTION UPON GENERAL COMMITTEE OF THE ENGINEERING DIVISION:** The five representatives of the Signal Section upon the General Committee of the Engineering Division shall be the Chairman, First Vice-Chairman, Second Vice-Chairman, and two members of the Committee of Direction to be selected by it.
24. **RECOMMENDED PRACTICES:**

Any definition, nomenclature, specification, recommended construction or recommended practice or any proposition having for its objective the formal declaration of the Section upon any matter of importance shall be presented in writing (accompanied by drawings if the latter are necessary for a clear understanding of the subject).

Such submissions will be presented to the Section at its Annual meeting for discussion, and following vote to decide whether or not the proposition shall be submitted to the voting members of Member Roads for adoption or rejection by letter ballot. If the vote to submit is affirmative, the Secretary within three months from the date of the meeting will distribute the ballots with a copy of the Minutes of the meeting, requesting their return within thirty days, naming the date. Ballots mailed after that date, as shown by the postmark, will not be counted. The Secretary shall announce the result of the ballot promptly to the Members. Ballots and envelopes shall be preserved for at least two years from date of announcement. The voting power of the Member Roads shall be as named in paragraph 26.
25. **VOTING AT MEETINGS OF SECTION:** Vote may be taken viva voce, by rising, by roll call or by ballot. Each Member Road shall be entitled to one vote, the ranking officer of a road present at any meeting being recognized as the voting representative of that road, unless otherwise designated by it. The vote of a majority of the Member Roads represented shall be required to decide any question, motion or resolution unless otherwise ordered, except that in the consideration of submitting a question to the letter ballot vote of the Member Roads, all representatives of Member Roads present at any meeting may vote. Thirty representatives of Member Roads shall constitute a quorum.

26. LETTER BALLOTS:

Letter ballots may be taken upon any subject by order of the Committee of Direction and *must* be taken on all questions affecting physical property. The voting power of the Member Roads shall be proportionate to ownership of signal equipment, one vote being counted for each

- 400 signals operating in two positions;
- 250 signals operating in three or four positions;
- 200 interlocked switches, power operated;
- 400 interlocked switches, manually operated;
- 250 highway crossings, automatically protected;
- 1600 train control inductors or loop circuits;
- 800 train control ramp (energized) magnet or coded circuits.

A fraction of a vote in the total of all items, if greater than one-half, shall be counted as one. Each Member Road shall have at least one vote.

Any proposition for which a majority of the votes are affirmative, shall be considered adopted.

27. ORDER OF BUSINESS: The order of business at meetings of the Section shall, unless otherwise directed by a majority of the members present, be as follows:

- Approval of Minutes of Last Meeting;
- Reports of Standing Committees;
- Reports of Special Committees;
- Unfinished Business;
- New Business.

28. Roberts' Rules of Order shall govern the proceedings of the Section, including amendment of these Rules of Order.

Sept. 1950]

RESULT OF LETTER BALLOT ON SUBJECTS APPROVED AT THE
ANNUAL MEETING, SEPTEMBER 12, 13 AND 14, 1949

All subjects have received the required affirmative letter ballot vote,
as follows:

	For	Against
<i>Committee I—Economics of Railway Signaling</i>		
Economic Statement—Form 24. (Superseding Economic Statement—Form 24, Manual Part 29.).....	920	0
<i>Committee II—Interlocking</i>		
Specification 147-49—Car Retarder System. (Superseding Specification 147-40, Manual Part 27.).....	921	0
Specification 245-49—Electric Car Retarder Control Machine. (New.)	921	0
Specification 241-49—Electro-Pneumatic Car Retarder Control Machine. (New.).....	921	0
Specification 246-49—Electric Car Retarder. (New.).....	921	0
Specification 242-49—Electro-Pneumatic Car Retarder. (New.)	921	0
Specification 247-49—Electric Switch Operating Mechanism for Yards. (New.).....	921	0
Specification 243-49—Electro-Pneumatic Switch Operating Mechanism for Yards. (New.).....	921	0
Specification 248-49—Electric Skate Operating Mechanism. (New.)	921	0
Specification 244-49—Electro-Pneumatic Skate Operating Mechanism. (New.).....	921	0
Specification 76-49—Electric Interlocking Machine. (Superseding section 11 of Specification 76-45, Manual Part 85.)	921	0
Specification 128-49—Mechanical Time Release. (Superseding section 1 of Specification 128-44, Manual Part 129.)..	921	0
<i>Committee IV—Automatic Block Signaling</i>		
Specification 151-49—Plug Type Rail Bonds and Track Circuit Connectors. (Superseding sections 7-d and 16-g-2 of Specification 151-42, Manual Part 112.).....	921	0
Specification 254-49—Twist Drills for Bond Holes. (New.)..	921	0
Instructions for Operation of Power Machines and Drilling of Holes for Rail Bonding. (New.).....	921	0
Instructions for Resharpening of Twist Drills for Bonding. (New.)	921	0
Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements. (Superseding Requisite 6-b of Requisites for Electric Locks Applied to Hand-Operated Switches for Protection of Main Track Movements, Manual Part 211.).....	921	0

	For	Against
<i>Committee IV—Automatic Block Signaling—Continued</i>		
Specification 180-49—Detachable Type Neutral Direct Current Relay for Non-Vital Circuits. (Superseding Specification 180-39, Manual Part 145.).....	921	0
Specification 80-49—Color Light Signal, Doublet Lens Type. (Superseding Specification 80-44, Manual Part 146.).....	921	0
Specification 81-49—Position Light Signal. (Superseding Specification 81-43, Manual Part 147.).....	921	0
Specification 249-49—Impulse Transformer for Coded System Control. (New.).....	921	0
Specification 154-49—Tractive Armature Direct Current Neutral Relay with Two Contact Fingers. (Superseding sections 1, 10-b to 10-k, inclusive, and 13, of Specification 154-39, Manual Part 101.).....	921	0
Specification 105-49—Tractive Armature Direct Current Neutral Relay with Two or More Contact Fingers. (Superseding sections 1, 10-b to 10-k, inclusive, and 13, of Specification 105-39, Manual Part 123.).....	921	0
Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data. (Superseding Formulae for Computing Minimum Allowable Resistance between Track Battery and Track and for Computing Related Current and Voltage Data, Manual Part 132.).....	921	0

Committee V—Contracts and Instructions

Definitions for Technical Terms Used in Signaling. (To be included in Manual Part 55.).....	921	0
Instructions for Direct Current Relays. (Superseding Table I—Operating Characteristics of Tractive Armature Direct Current Relay, of Instructions for Direct Current Relays, Manual Part 126.).....	921	0
Instructions for Time Releases Applied to Signal Apparatus. (Superseding Instructions for Time Releases Applied to Signal Apparatus, Manual Part 128.).....	868	53
Instructions for Wire and Cable. (Superseding Instructions for Wire and Cable, Manual Part 190.).....	921	0
Instructions for Car Retarder Systems. (Superseding Instructions 25, 26, 27 and 28 of Instructions for Car Retarder Systems, Manual Part 125.).....	921	0
Instructions for Interlocking. (Superseding Instructions 1 to and including 35 of Instructions for Interlocking, Manual Part 138.)	921	0
Circuit Nomenclature and Written Circuits. (To be included in Manual Part 33.).....	921	0
A.A.R. Sig. Sec. 1664C—Graphical Symbols—Wayside Fixtures. (Superseding A.A.R. Sig. Sec. 1664B in the Manual.)	921	0

For Against

Committee V—Contracts and Instructions—Continued

A.A.R. Sig. Sec. 1673D (Three Sheets)—Graphical Symbols—Relays. (Superseding A.A.R. Sig. Sec. 1673C (Three Sheets) in the Manual.).....	921	0
A.A.R. Sig. Sec. 1674E (Three Sheets)—Graphical Symbols—Relay Contacts. (Superseding A.A.R. Sig. Sec. 1674D (Three Sheets) in the Manual.).....	921	0

Committee VI—Designs

A.A.R. Sig. Sec. 1056F—Terminal Blocks—Short Type. (Superseding A.A.R. Sig. Sec. 1056E in the Manual.)....	921	0
A.A.R. Sig. Sec. 1077B—Terminal Block—Long Type. (Superseding A.A.R. Sig. Sec. 1077A in the Manual.)....	921	0
A.A.R. Sig. Sec. 1446C—Electric Light Unit for Semaphore Lighting. (Superseding A.A.R. Sig. Sec. 1446B in the Manual.)	921	0
A.A.R. Sig. Sec. 1645D—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Assembly. (Superseding A.A.R. Sig. Sec. 1645C in the Manual.).....	921	0
A.A.R. Sig. Sec. 1656D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8-Inch Pipe—Assemblies. (Superseding A.A.R. Sec. 1656C in the Manual.)	921	0
A.A.R. Sig. Sec. 1657D—Cross-Arms for Flashing Light Highway Crossing Signals without Gates—4 to 8-Inch Pipe—Details. (Superseding A.A.R. Sig. Sec. 1657C in the Manual.)	921	0
A.A.R. Sig. Sec. 1492A—Crossing Gate Sidewalk Arm. (New.)	921	0
A.A.R. Sig. Sec. 1700A—Number of Tracks Sign—Reflector Type for 4 to 8-Inch Pipe—Details and Assemblies. (New.)	921	0
R.S.A. 1175—Hydrometer (Stationary Lead Type Storage Battery). To be removed from the Manual.).....	921	0
A.A.R. Sig. Sec. 1375B—Thermometer—Lead Type Storage Battery. (To be removed from the Manual.).....	921	0
Drawing 1456—Torque Testing Apparatus. (To be removed from the Manual.).....	921	0
A.A.R. Sig. Sec. 1624A—Tension Test Specimen. (To be removed from the Manual.).....	921	0
Specification 174-49—Electric Light Unit for Semaphore Signal. (Superseding Specification 174-46, Manual Part 12.)	921	0
Specification 236-49—Electric Light Unit for Highway Crossing Gate Arm. (New.).....	921	0
Specification 190-49—Electric Light Unit for Highway Crossing Signal—Reflector Type. (Superseding Specification 190-42, Manual Part 166.).....	921	0

For Against

Committee VI—Designs—Continued

Specification 156-49—Reflector Unit. (Superseding Specification 156-40, Manual Part 43.).....	921	0
Specification 51-49—Incandescent Electric Lamps. (Superseding Appendix of Specification 51-46, Manual Part 91.)	921	0

Committee VII—Materials Research

Specification 251-49—Paint for Finishing Coats on Wood Structures. (New.)	921	0
Specification 252-49—Paint for Finishing Coats on Steel and Iron Structures. (New.).....	921	0
Specification 253-49—Enamel Paint for Finishing Coats on Wood Structures. (New.).....	921	0
Specification 250-49—Pressure Gun Grease. (New.).....	921	0
Specification for Electrolyte. (Superseding Specification for Electrolyte, Manual Part 13.).....	921	0
Specification 53-49—Lead Acid Stationary Storage Battery—Positive Plates of Composite Structure Supporting Active Material in the Form of Pure Lead. (Superseding Specification 53-39, Manual Part 18.).....	921	0
Specifications for Various Types of Non-Ferrous Metals and Alloys. (Superseding Specifications for Various Types of Non-Ferrous Metals and Alloys, Manual Part 220.).....	921	0

Committee VIII—Highway Grade Crossing Protection

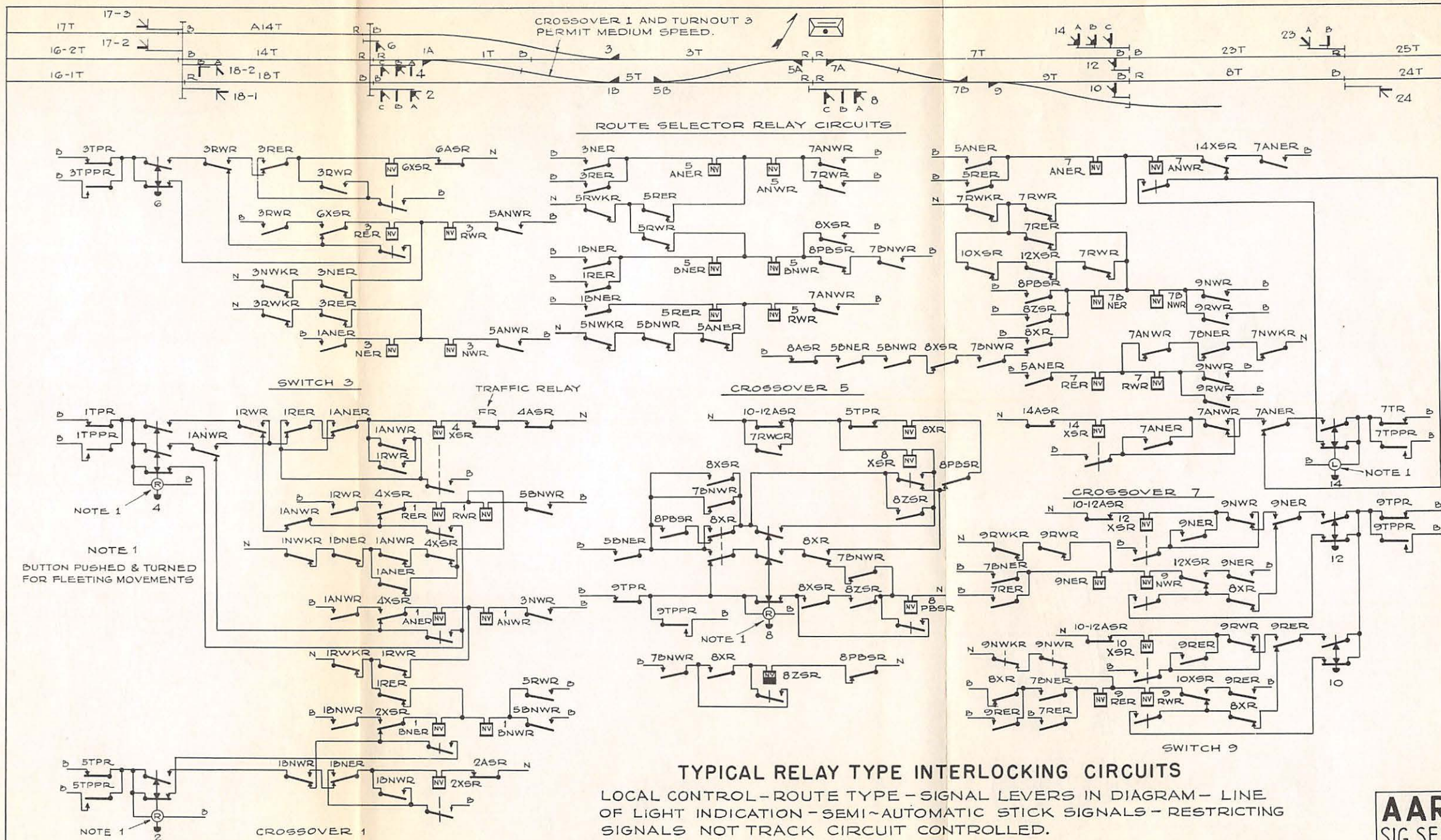
Instructions for Focusing and Aligning Railroad Highway Grade Crossing Flashing Light Signal Units, Reflector Type, with Sealed Lamp Receptacle. (New.).....	920	1
Signs Used in Connection with Manually Protected Railroad Highway Grade Crossings, and Advance Warning Signs. (New.)	921	0

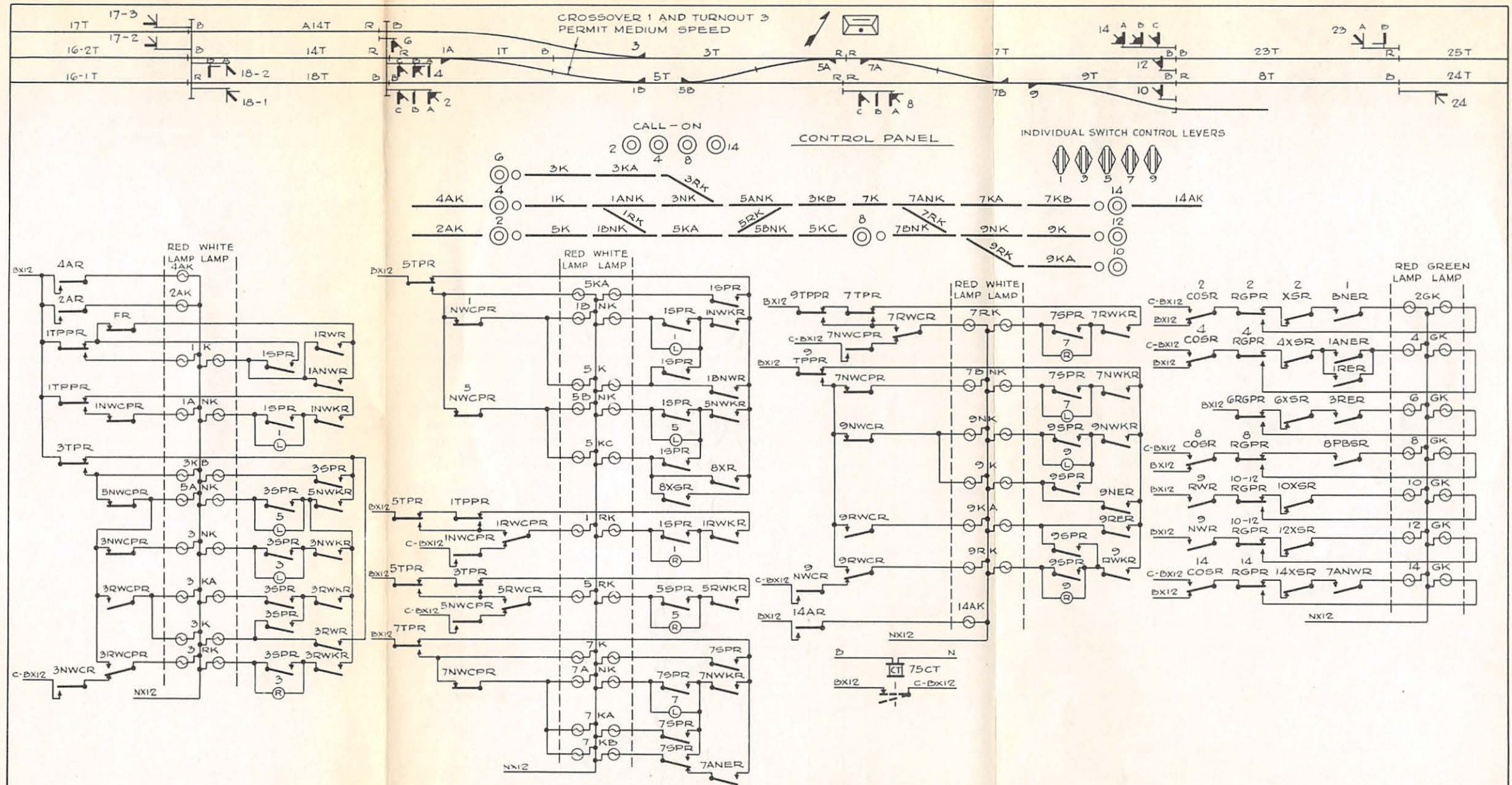
Committee IX—Overhead and Underground Lines

Specification for the Joint Use of Poles for Power, Communication and Signal Circuits on Railroad Property. (New)	920	0
---	-----	---

Committee XI—Electronics

Electronic Terms and Symbols Used in Signaling. (New.)....	920	1
--	-----	---



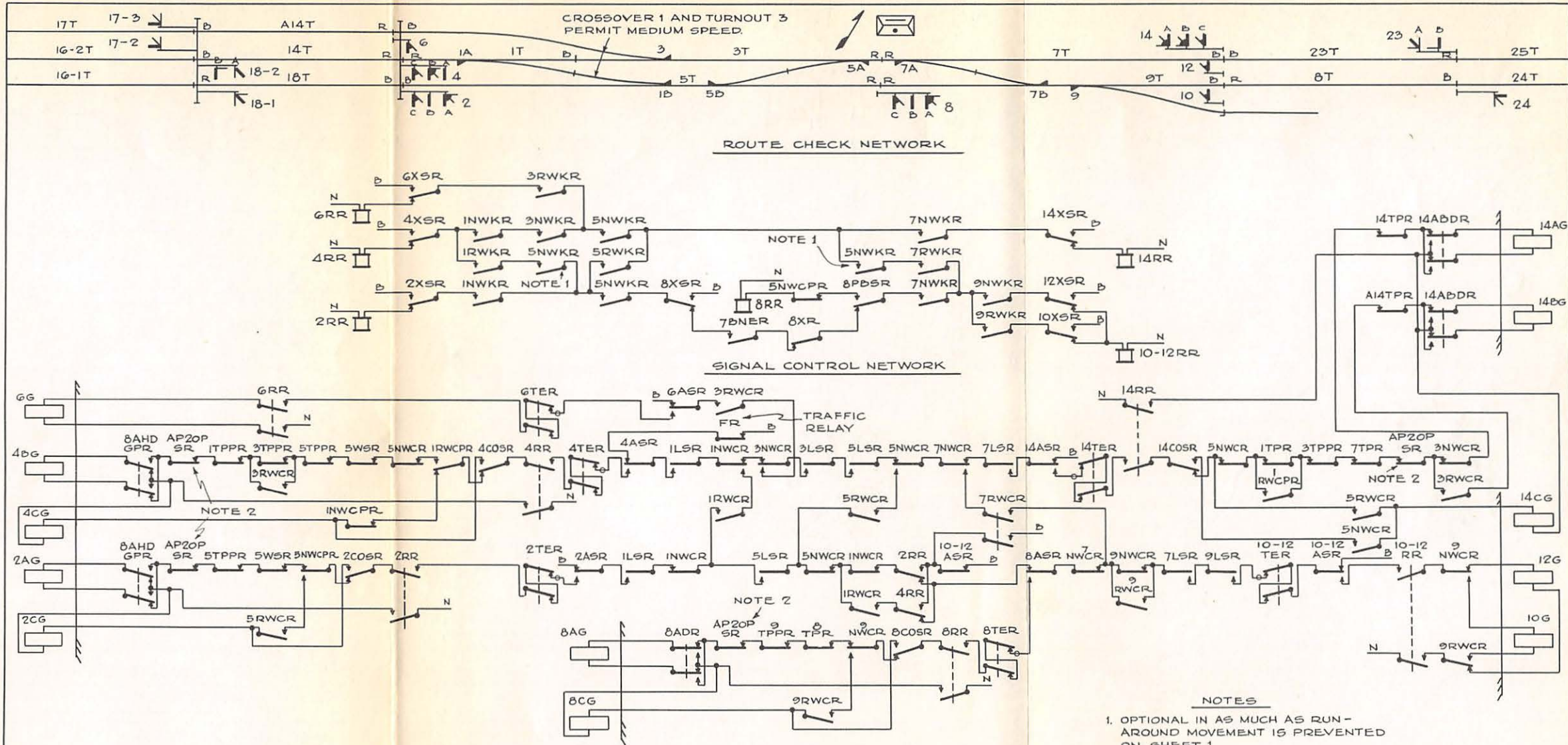


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL-ROUTE TYPE-SIGNAL LEVERS IN DIAGRAM-LINE
OF LIGHT INDICATION-SEMI-AUTOMATIC STICK SIGNALS-RESTRICTING
SIGNALS NOT TRACK CIRCUIT CONTROLLED.

SEPT. 1950

AAR
SIG. SEC.
8025A

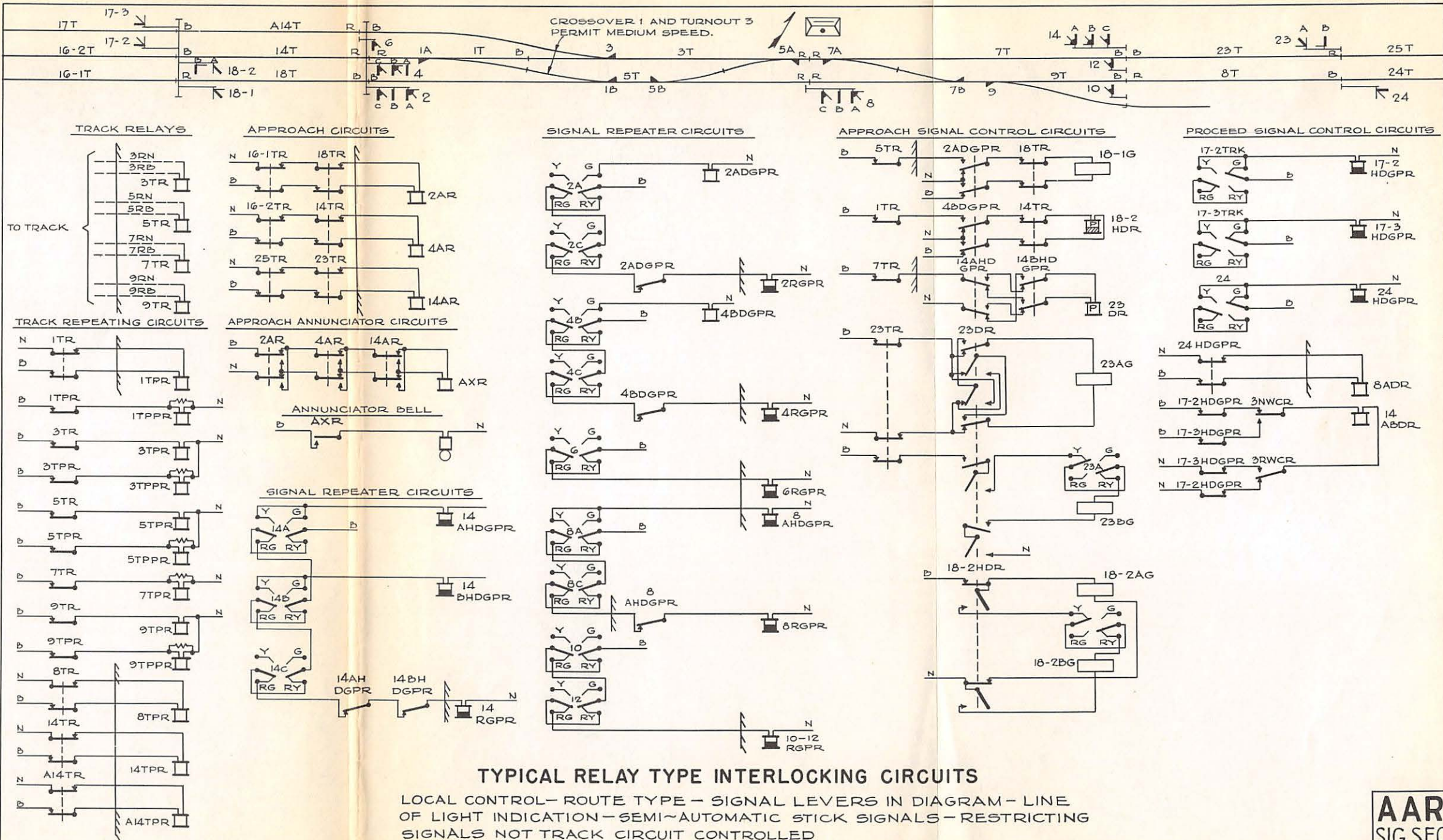


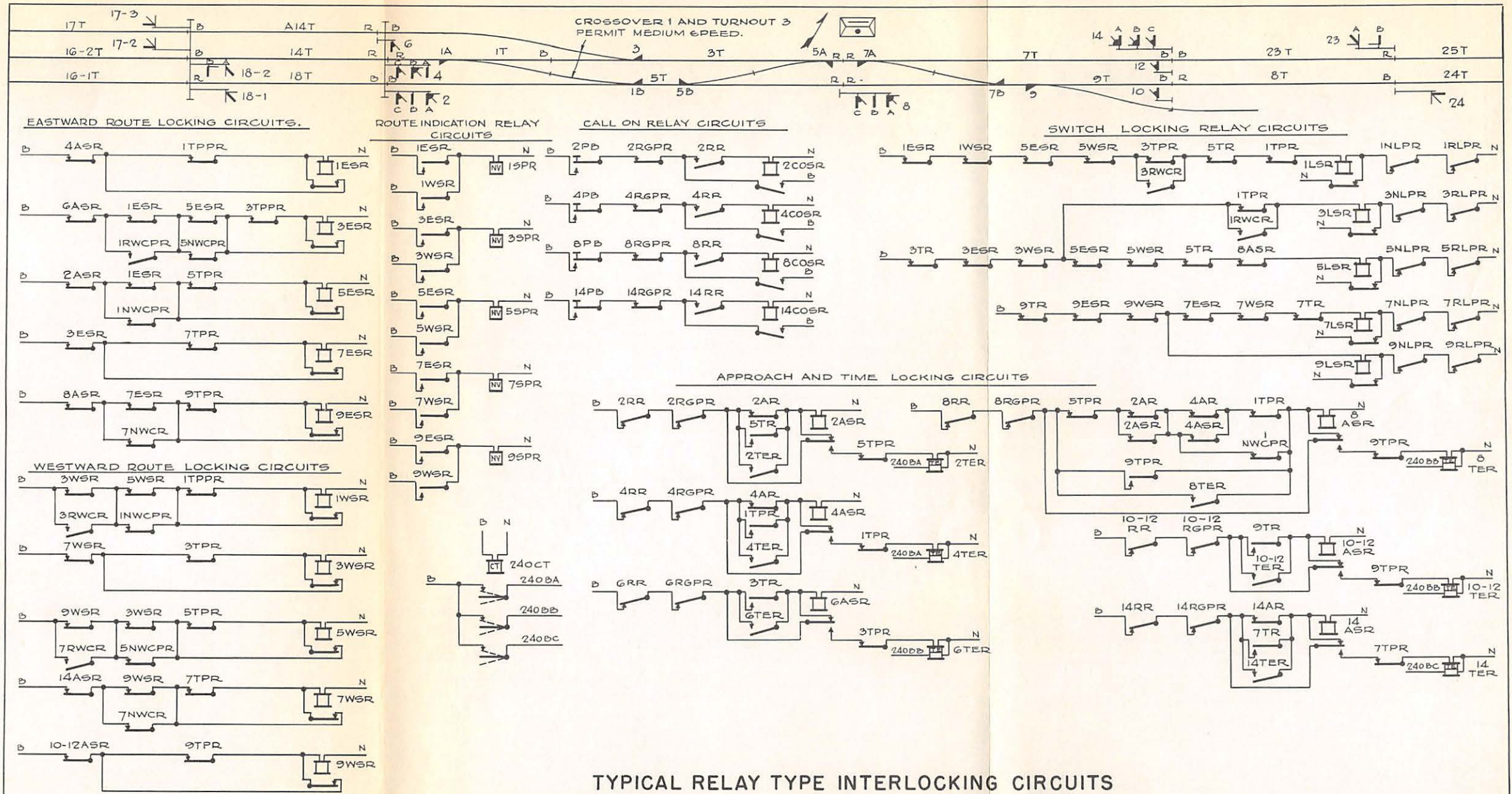
TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS IN DIAGRAM - LINE
OF LIGHT INDICATION - SEMI-AUTOMATIC STICK SIGNALS - RESTRICTING
SIGNALS NOT TRACK CIRCUIT CONTROLLED.

1. OPTIONAL IN AS MUCH AS RUN-AROUND MOVEMENT IS PREVENTED ON SHEET 1.
2. CONTACT AP2OPSR REQUIRED FOR ELECTRO-PNEUMATIC INTERLOCKING ONLY.

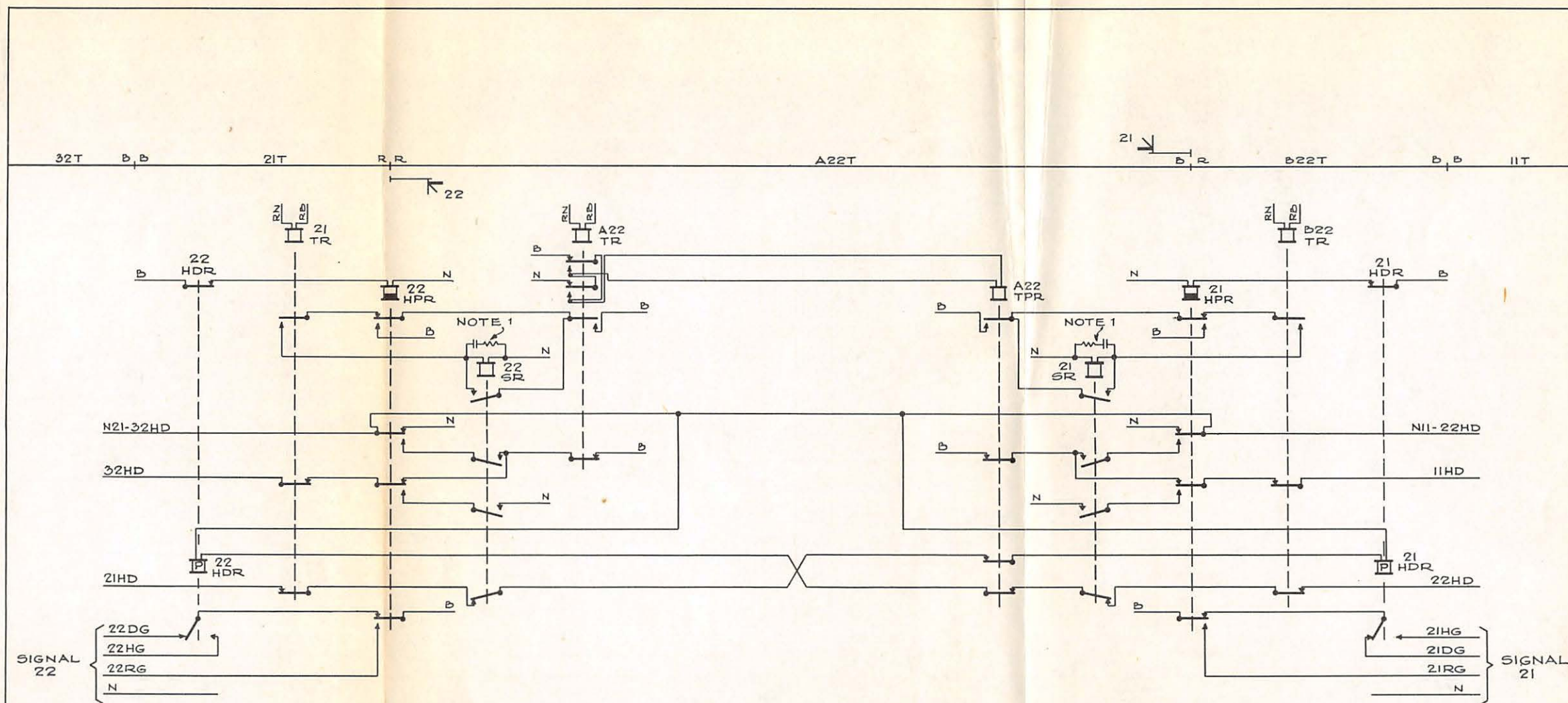
AAR
SIG.SEC.
8025A





TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL-ROUTE TYPE-SIGNAL LEVERS IN DIAGRAM-LINE
OF LIGHT INDICATION-SEMI-AUTOMATIC STICK SIGNALS-RESTRICTING
SIGNALS NOT TRACK CIRCUIT CONTROLLED.



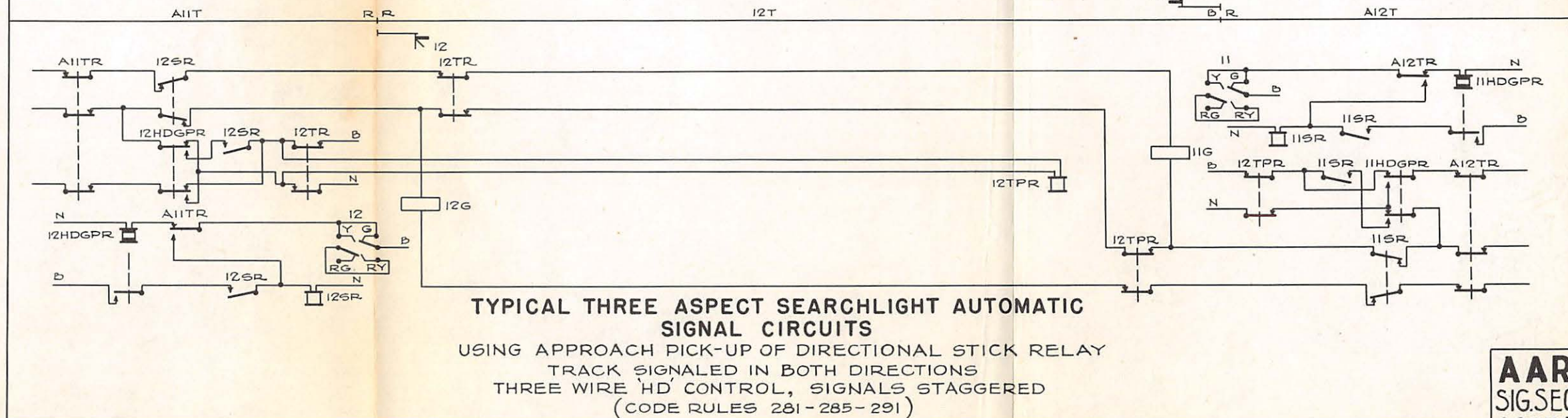
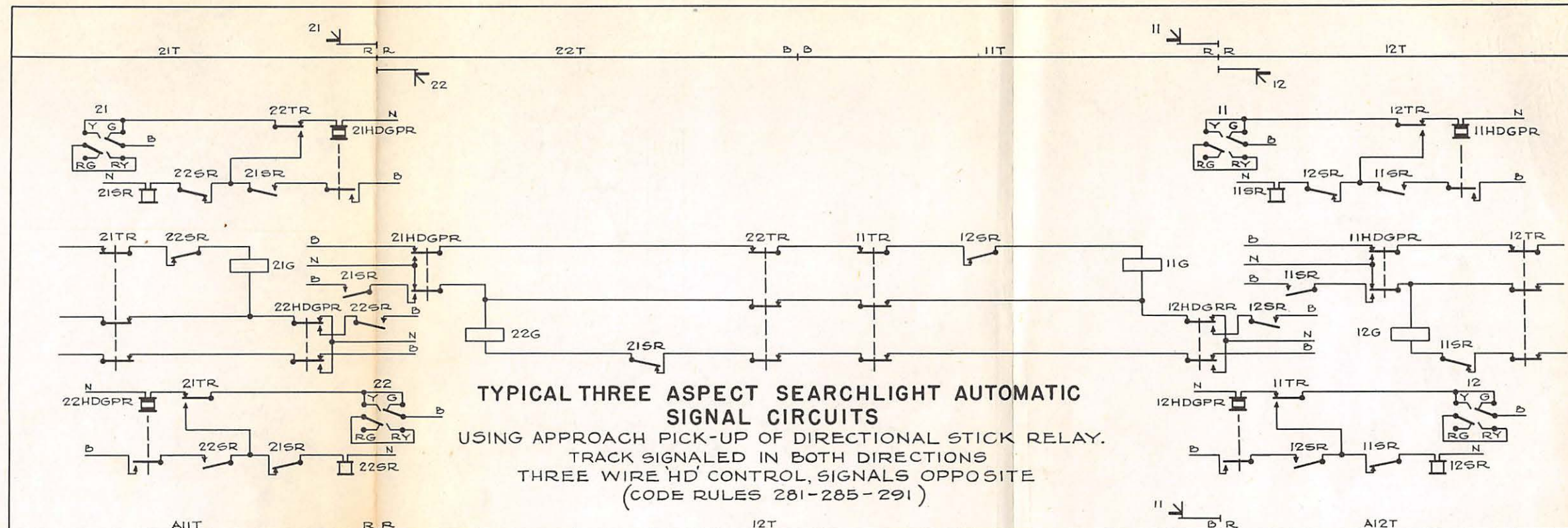
TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS

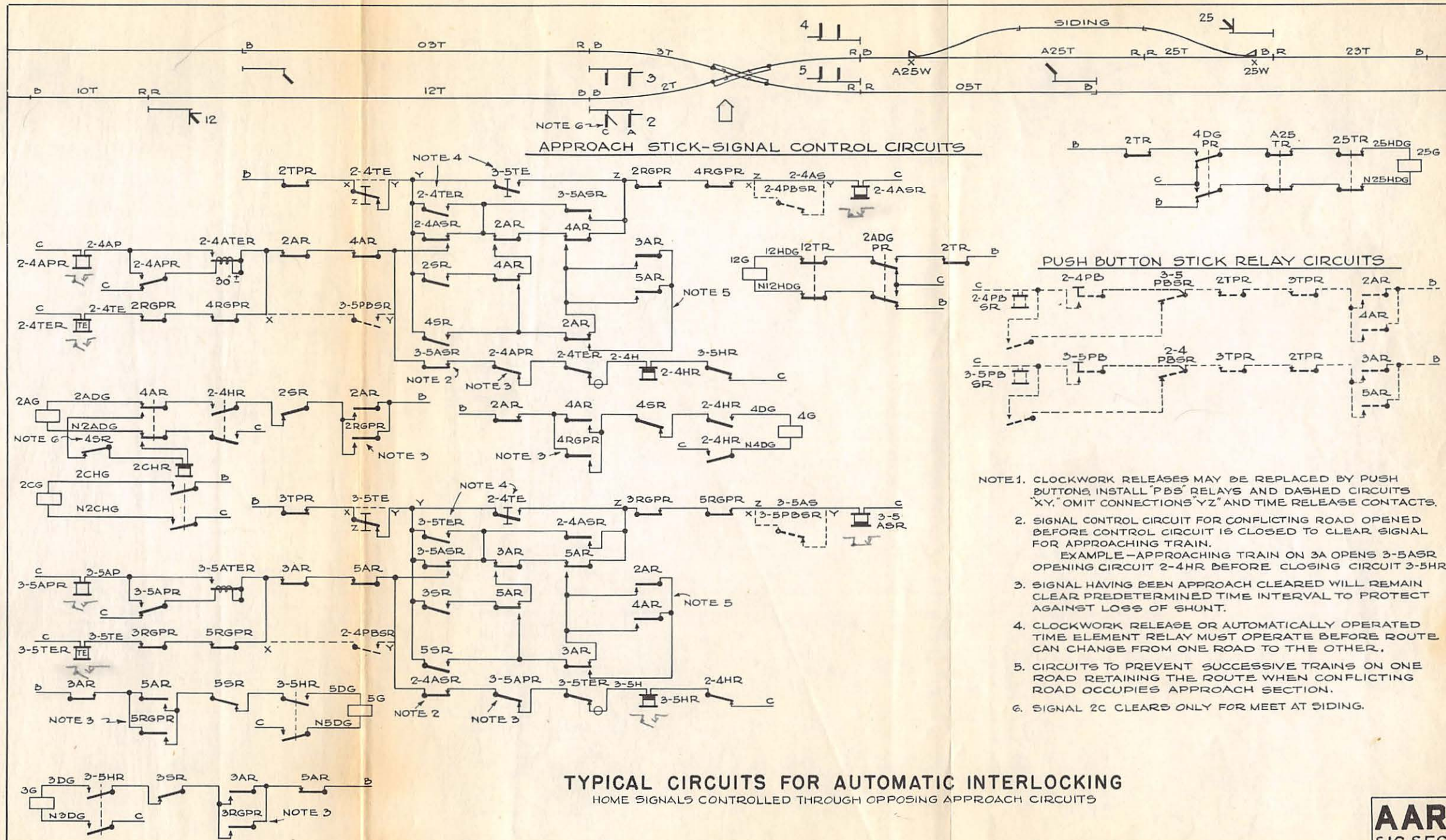
USING DIRECT POLARIZED LINE CONTROL - STAGGERED LOCATIONS
TRACK SIGNALLED IN BOTH DIRECTIONS
THREE WIRE 'HD' CONTROL
(CODE RULES 281-285-291)

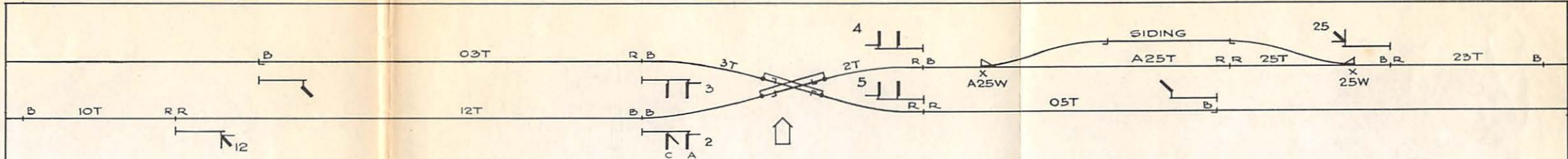
NOTE 1
USE OF CONDENSER-RESISTOR
SNUB OPTIONAL.

AAR
SIG.SEC.
8027A

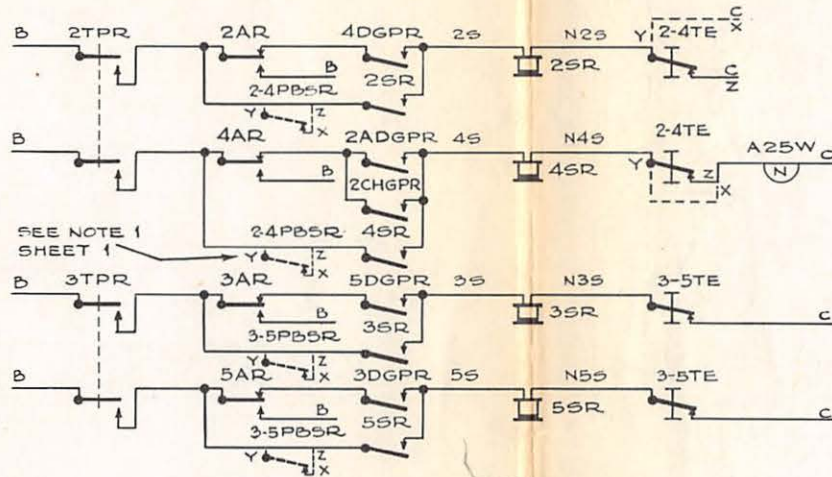
SEPT 1950



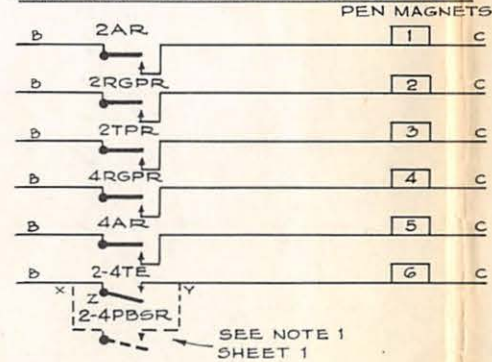




DIRECTIONAL STICK RELAY CIRCUITS

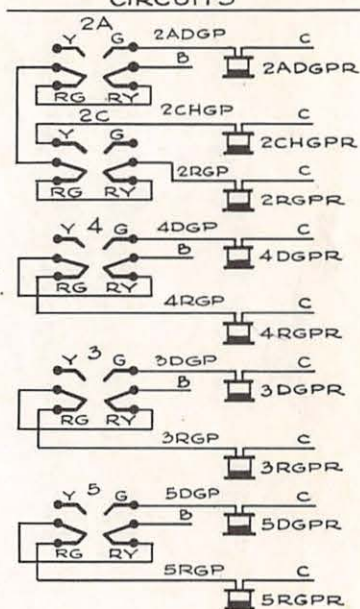


GRAPHIC RECORDER CIRCUITS

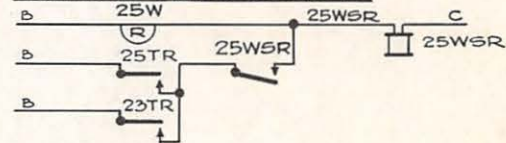


PENS 7 TO 12 TO BE USED FOR RECORDING
DATA ON CONFLICTING ROAD

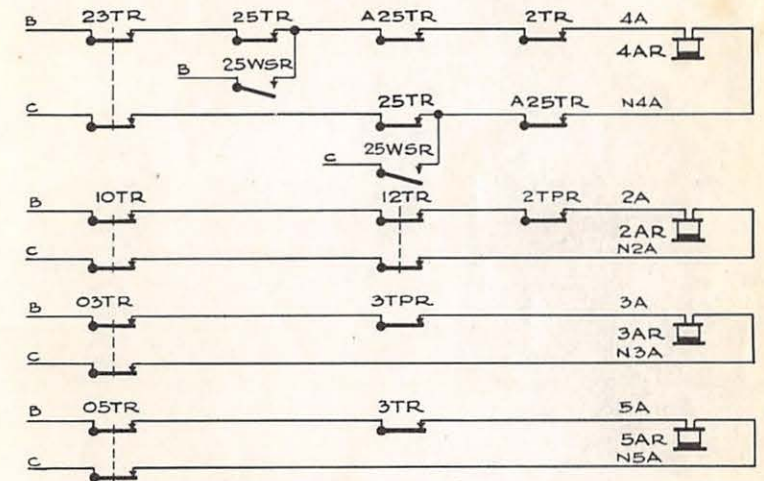
SIGNAL REPEATER RELAY CIRCUITS



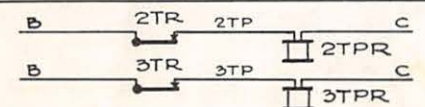
SWITCH STICK CIRCUIT



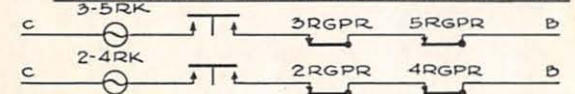
APPROACH RELAY CIRCUITS



TRACK REPEATER RELAY CIRCUITS

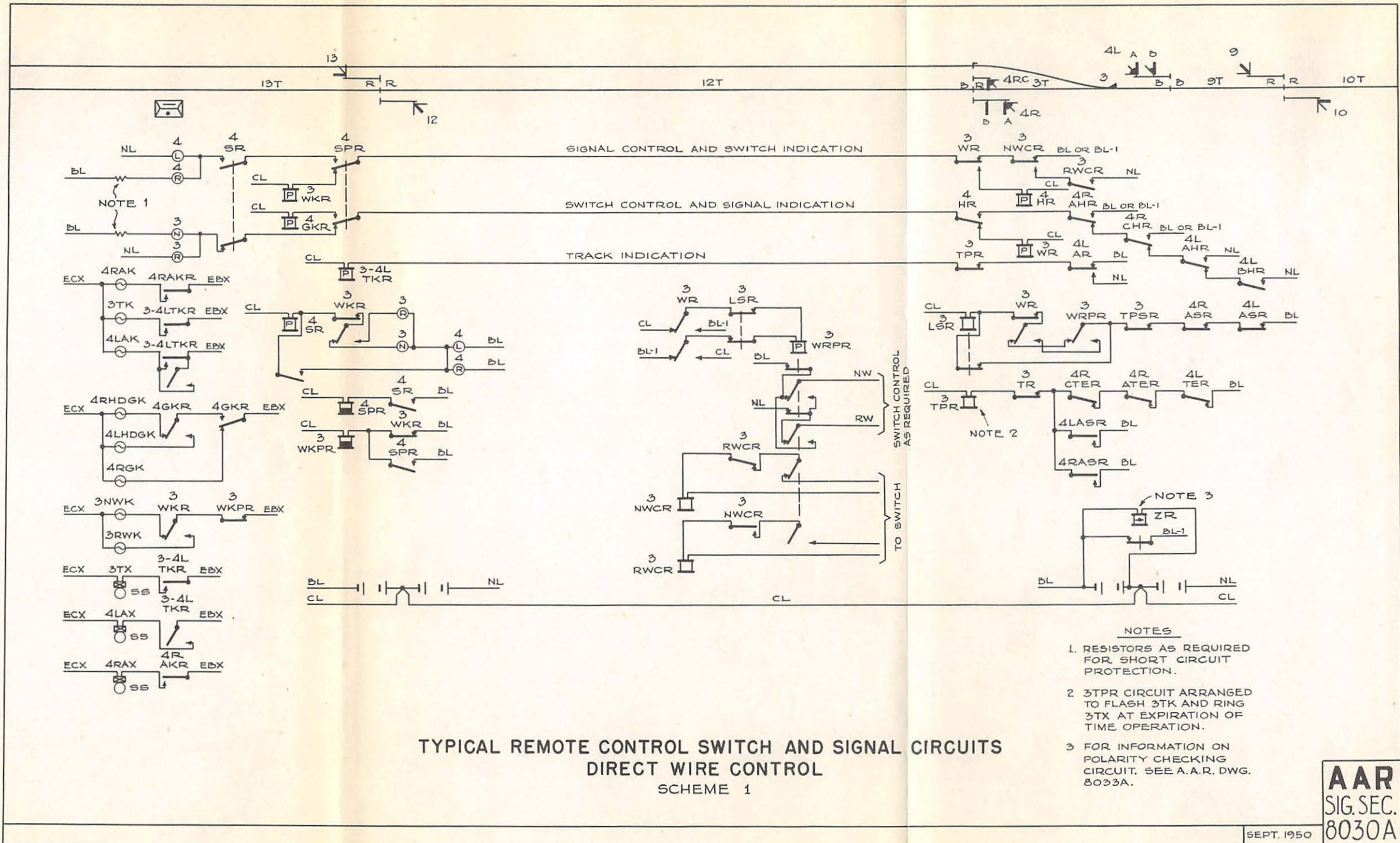


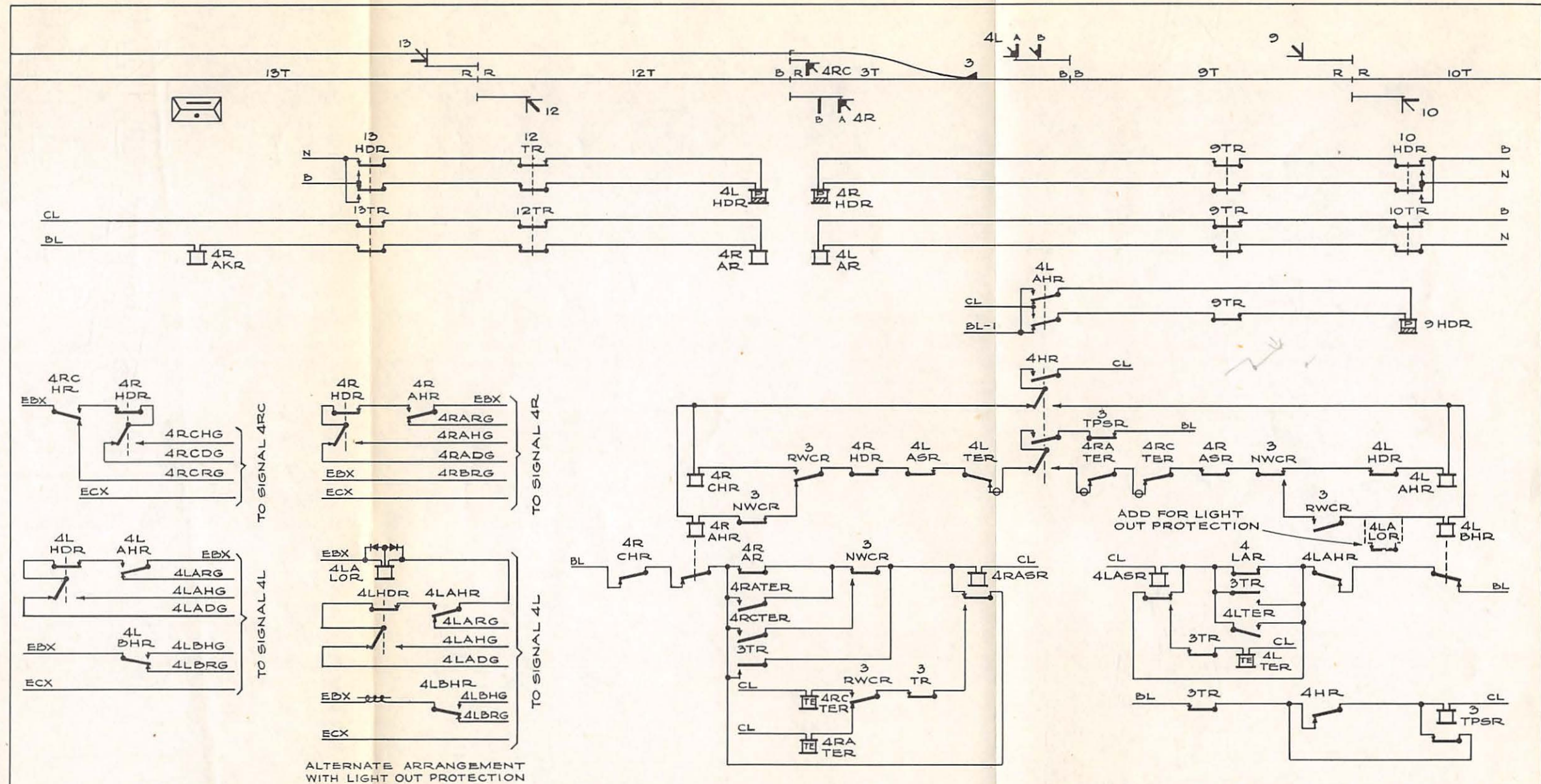
RED SIGNAL INDICATOR CIRCUITS



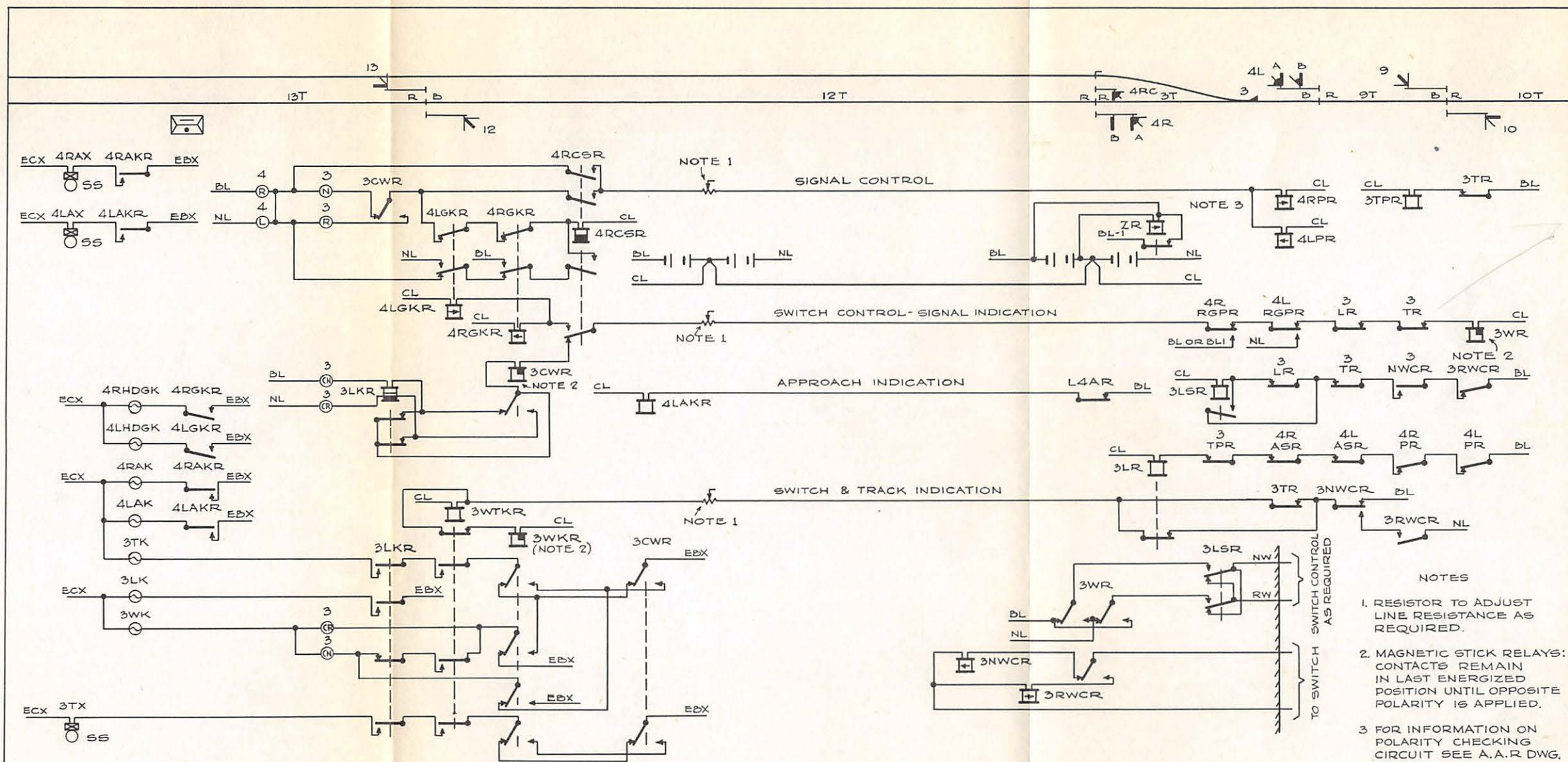
TYPICAL CIRCUITS FOR AUTOMATIC INTERLOCKING

HOME SIGNALS CONTROLLED THROUGH OPPOSING APPROACH CIRCUITS

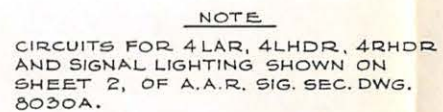




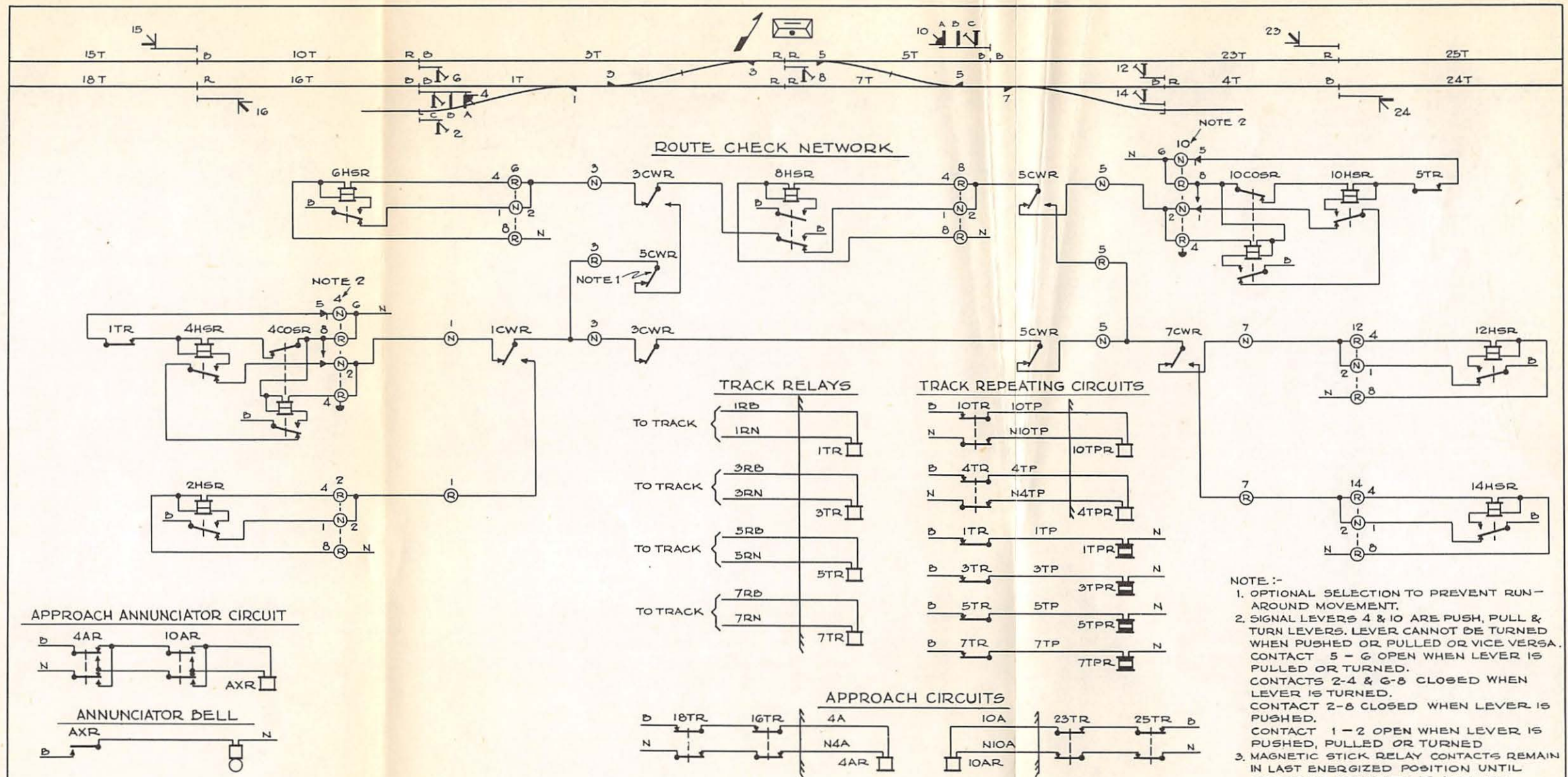
TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS
DIRECT WIRE CONTROL.
SCHEME 1



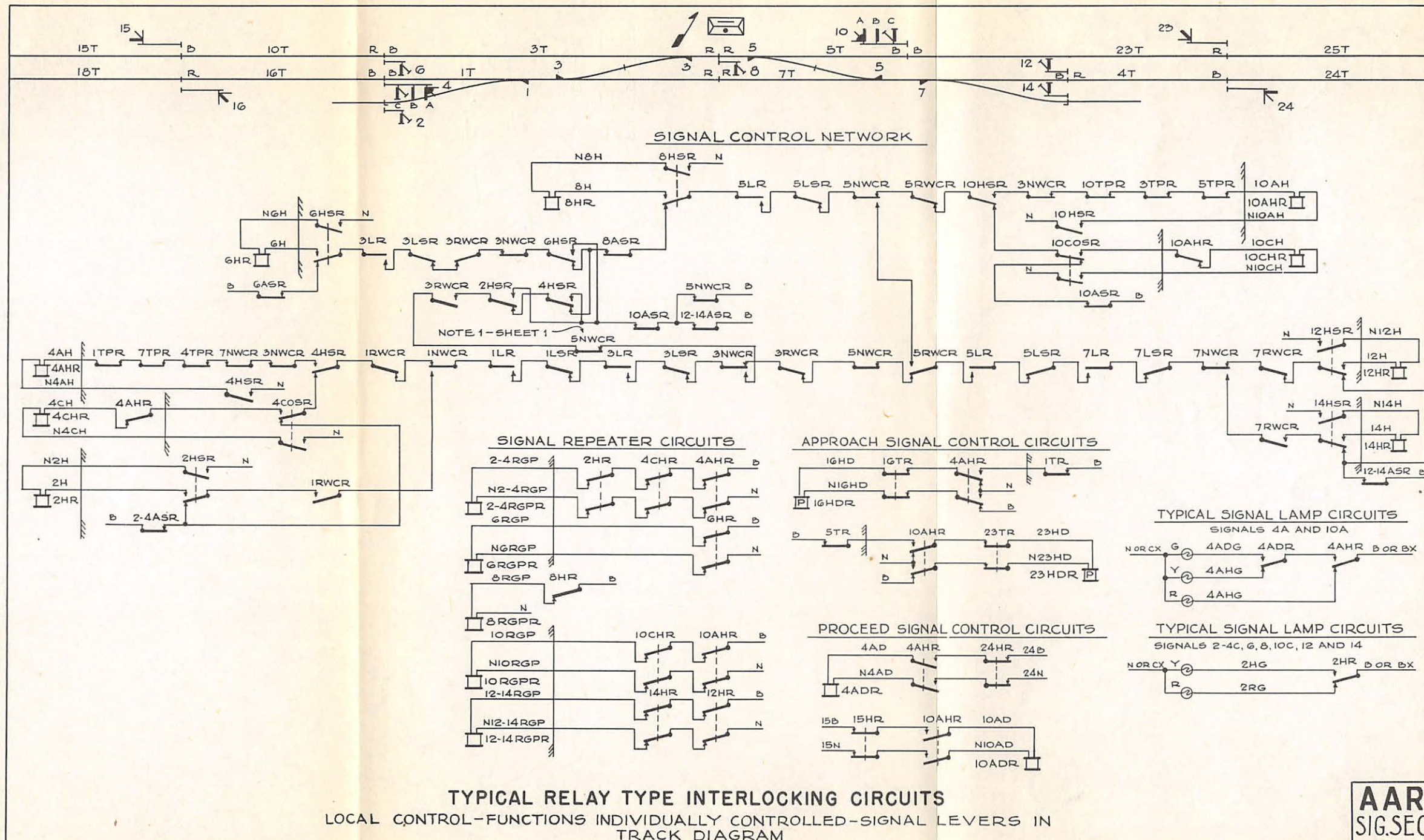
TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS
DIRECT WIRE CONTROL
SCHEME 2

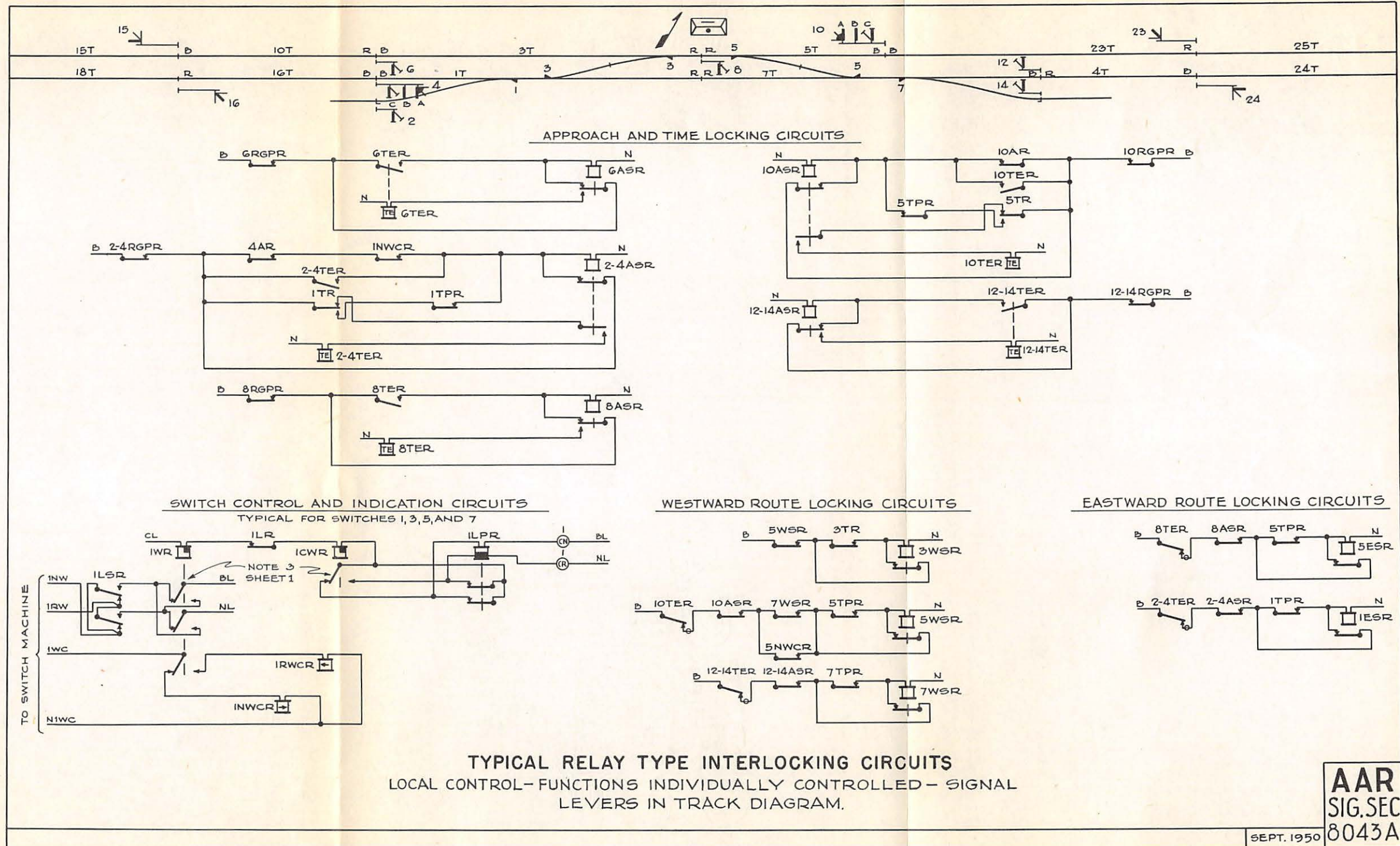


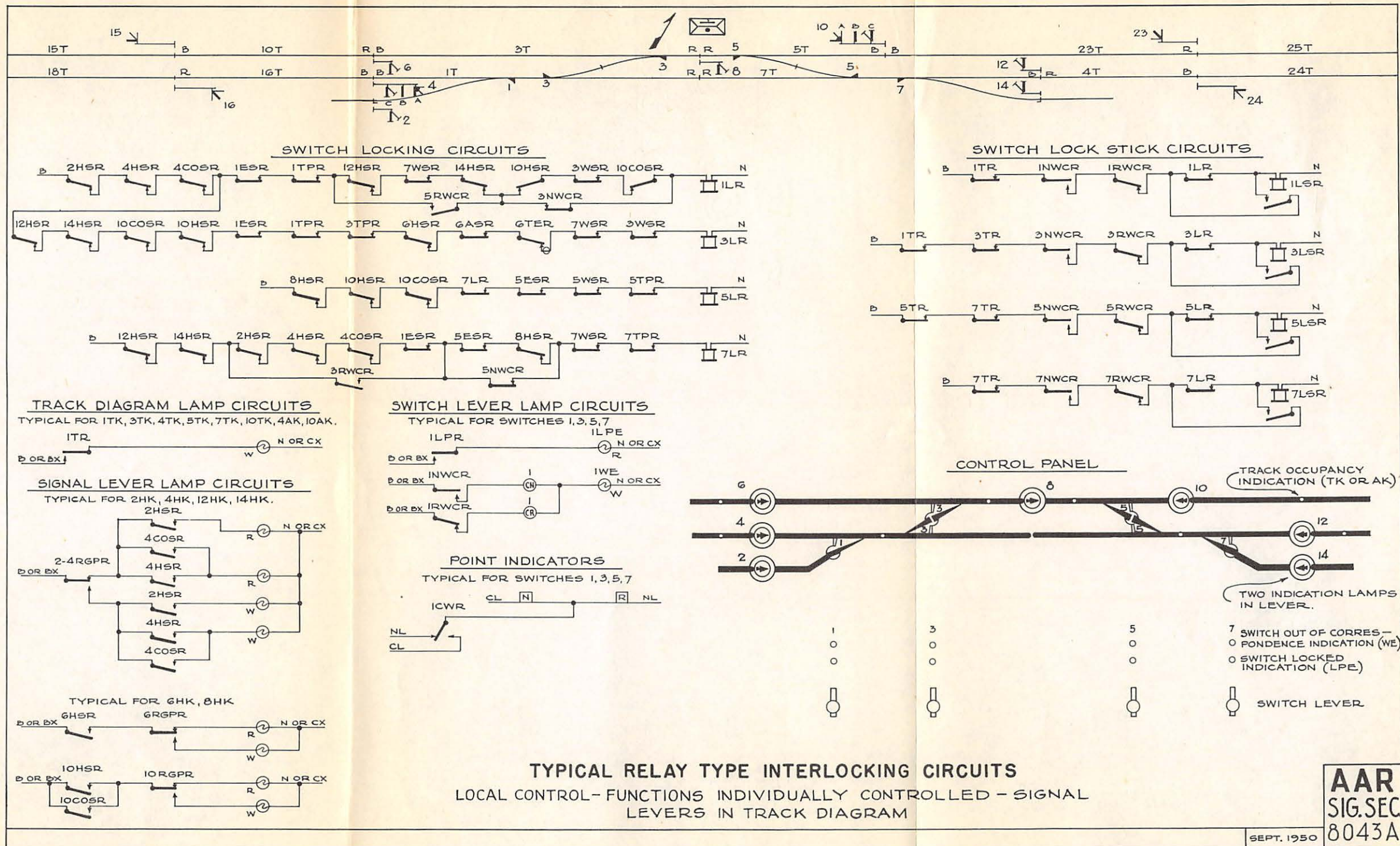
TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS
DIRECT WIRE CONTROL
SCHEME 2

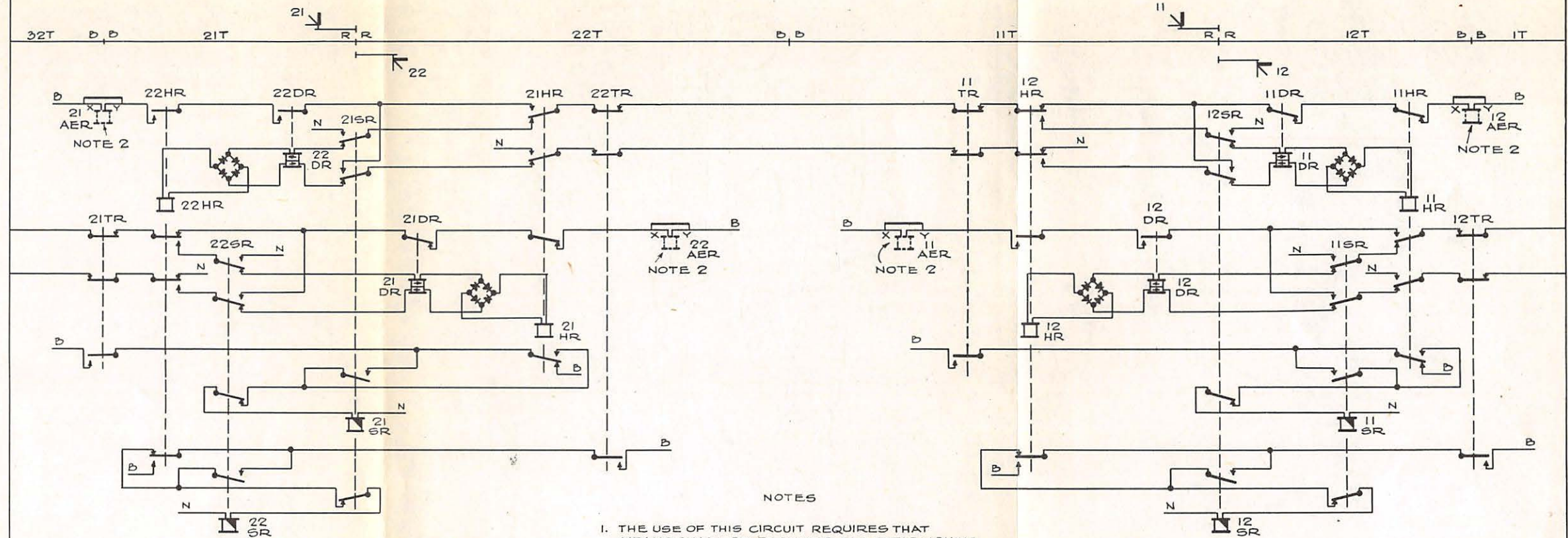


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS
LOCAL CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED - SIGNAL
LEVERS IN TRACK DIAGRAM.





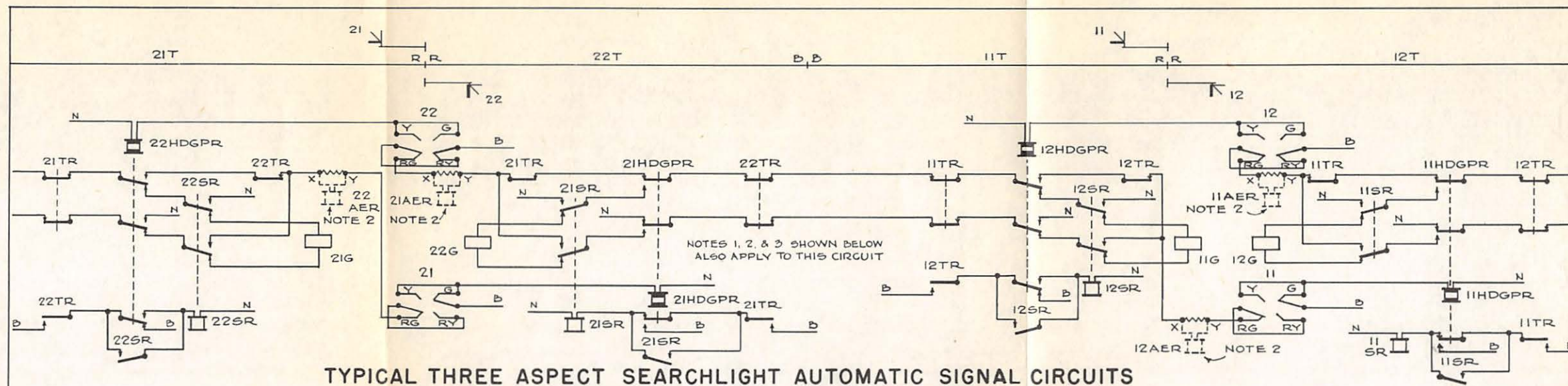




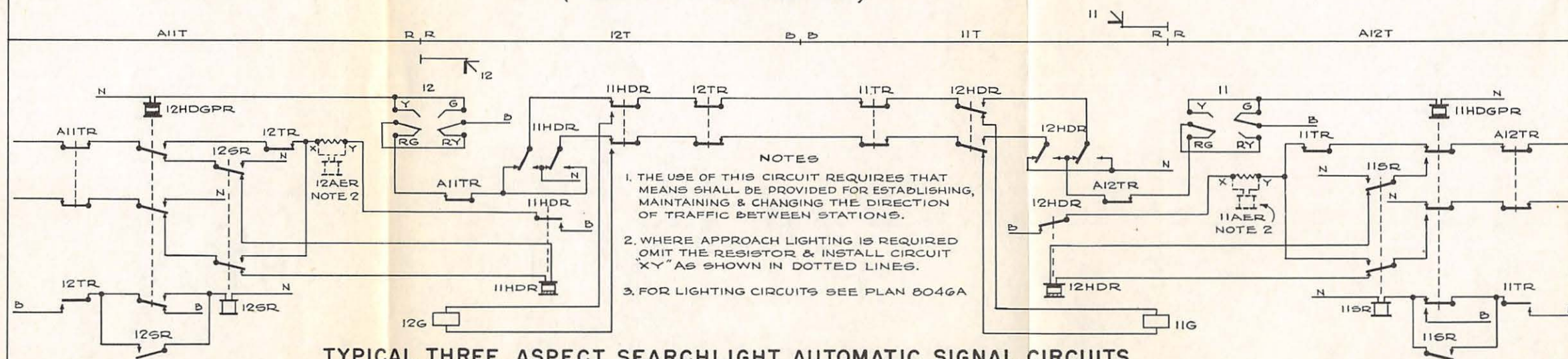
NOTES

1. THE USE OF THIS CIRCUIT REQUIRES THAT MEANS SHALL BE PROVIDED FOR ESTABLISHING, MAINTAINING & CHANGING THE DIRECTION OF TRAFFIC BETWEEN STATIONS.
2. WHERE APPROACH LIGHTING RELAY IS REQUIRED, OMIT HEAVY LINE CIRCUIT & INSTALL CIRCUIT 'XY' AS SHOWN ON DOTTED LINES.
3. FOR LIGHTING CIRCUITS SEE PLAN 8046A,

TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS
USING BIASED NEUTRAL 'D' RELAY AND NEUTRAL 'H' RELAY.
TRACK SIGNALLED IN BOTH DIRECTIONS
TWO WIRE 'HD' CONTROL
(CODE RULES 281-285-291)



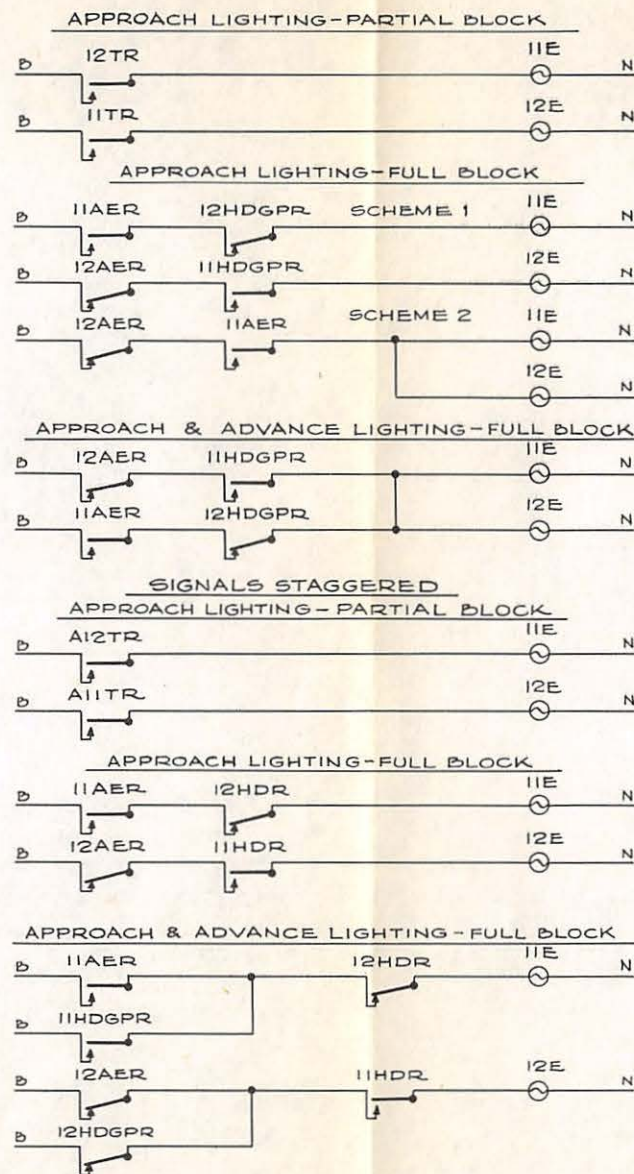
TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS
USING DIRECT POLARIZED LINE CONTROL
TRACK SIGNALLED IN BOTH DIRECTIONS
TWO WIRE CONTROL - SIGNALS OPPOSITE
(CODE RULES 281-285-291)



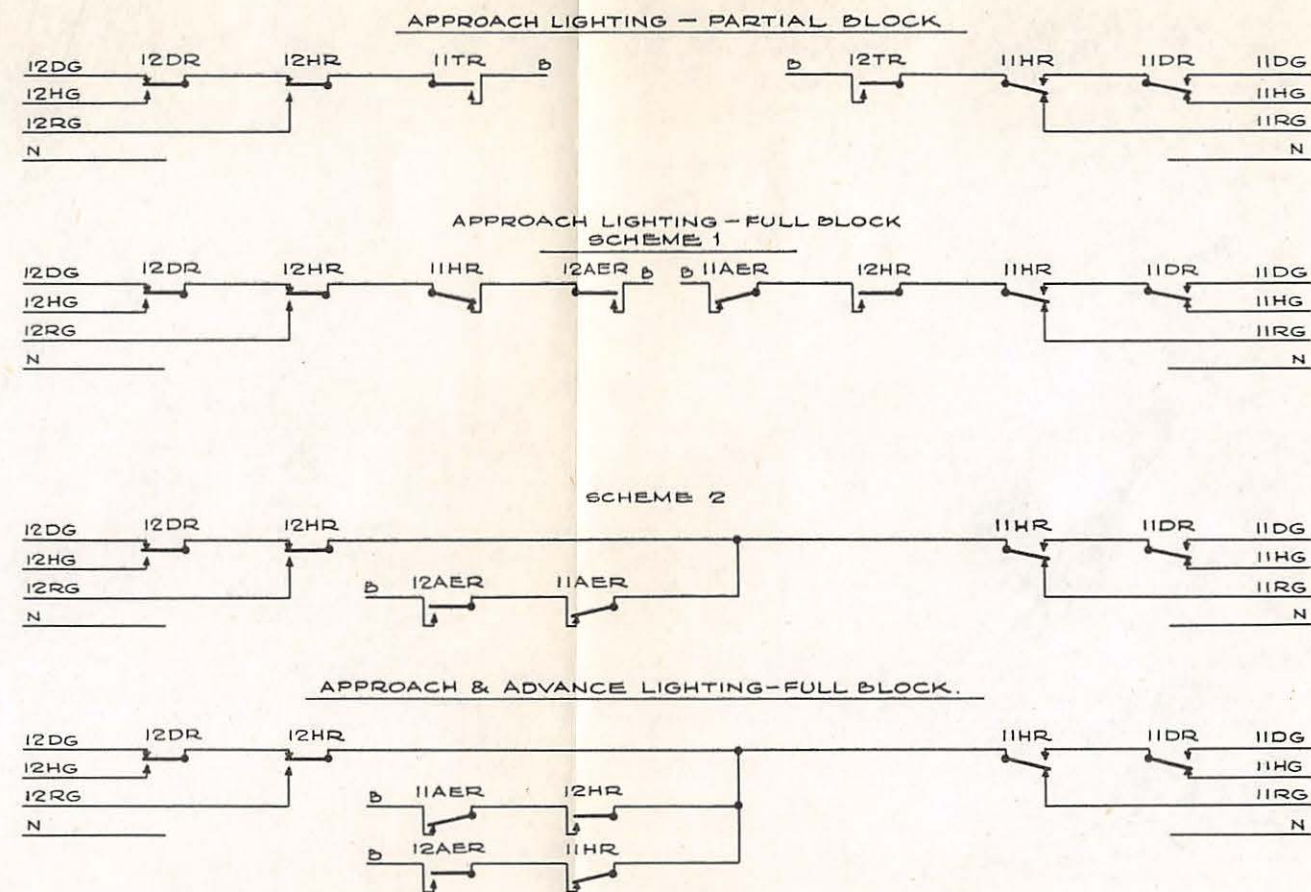
TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS
USING DIRECT POLARIZED LINE CONTROL AND RETAINED
NEUTRAL POLAR LINE RELAYS
TRACK SIGNALLED IN BOTH DIRECTIONS
TWO WIRE CONTROL - SIGNALS STAGGERED
(CODE RULES 281-285-291)

- NOTES**
1. THE USE OF THIS CIRCUIT REQUIRES THAT MEANS SHALL BE PROVIDED FOR ESTABLISHING, MAINTAINING & CHANGING THE DIRECTION OF TRAFFIC BETWEEN STATIONS.
 2. WHERE APPROACH LIGHTING IS REQUIRED OMIT THE RESISTOR & INSTALL CIRCUIT "XY" AS SHOWN IN DOTTED LINES.
 3. FOR LIGHTING CIRCUITS SEE PLAN 8046A

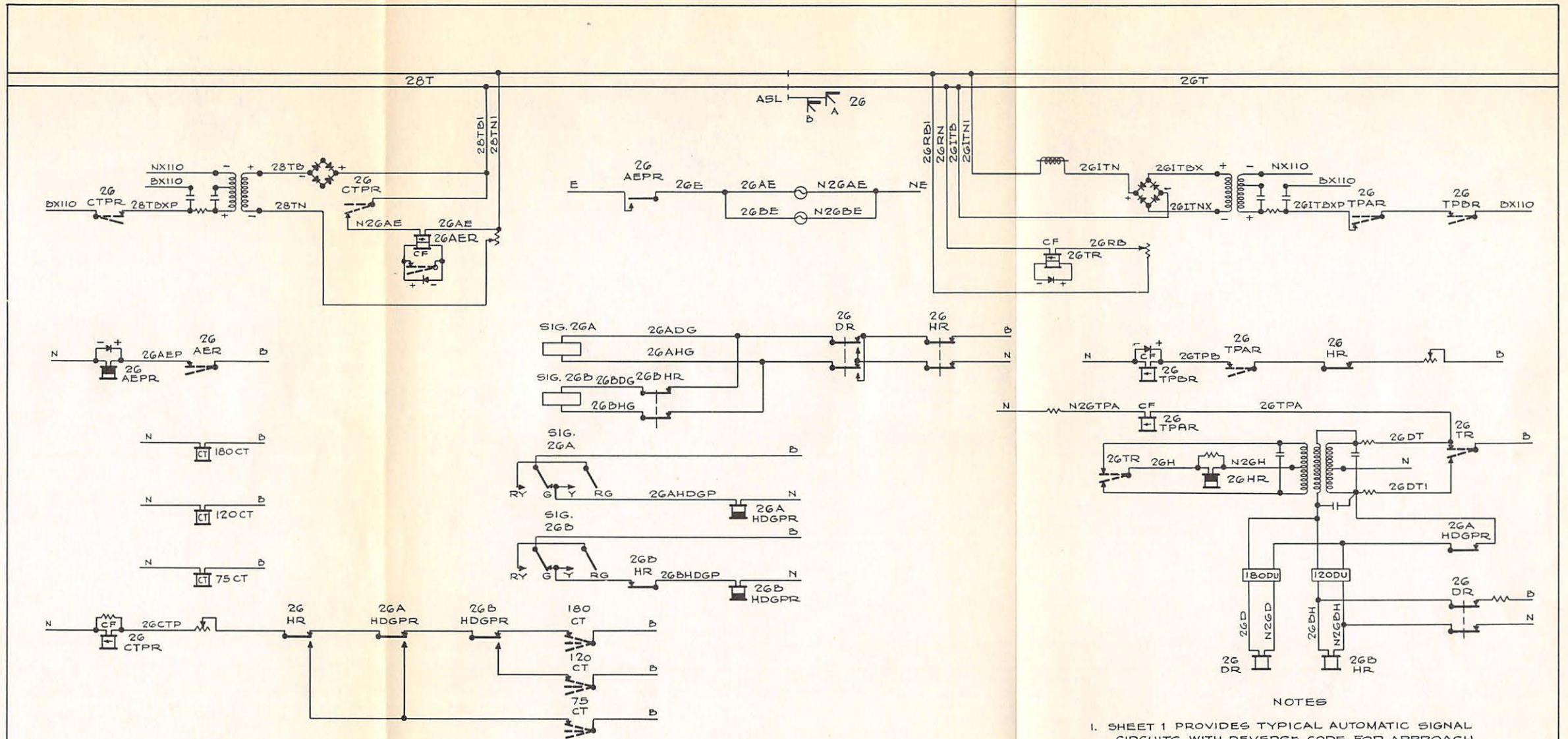
SEARCHLIGHT SIGNALS SIGNALS OPPOSITE



COLOR LIGHT SIGNALS

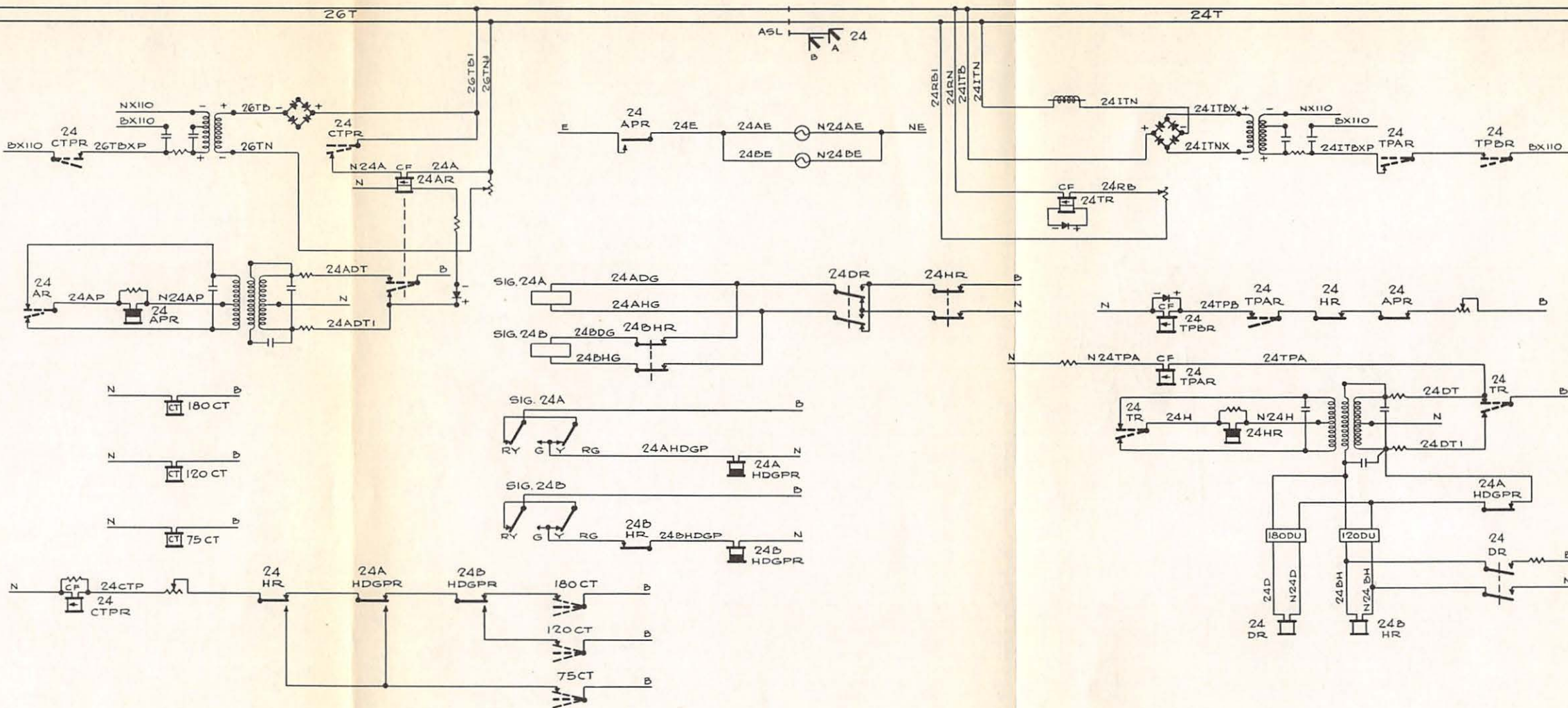


APPROACH LIGHTING CIRCUITS
FOR PLANS 8044A & 8045A

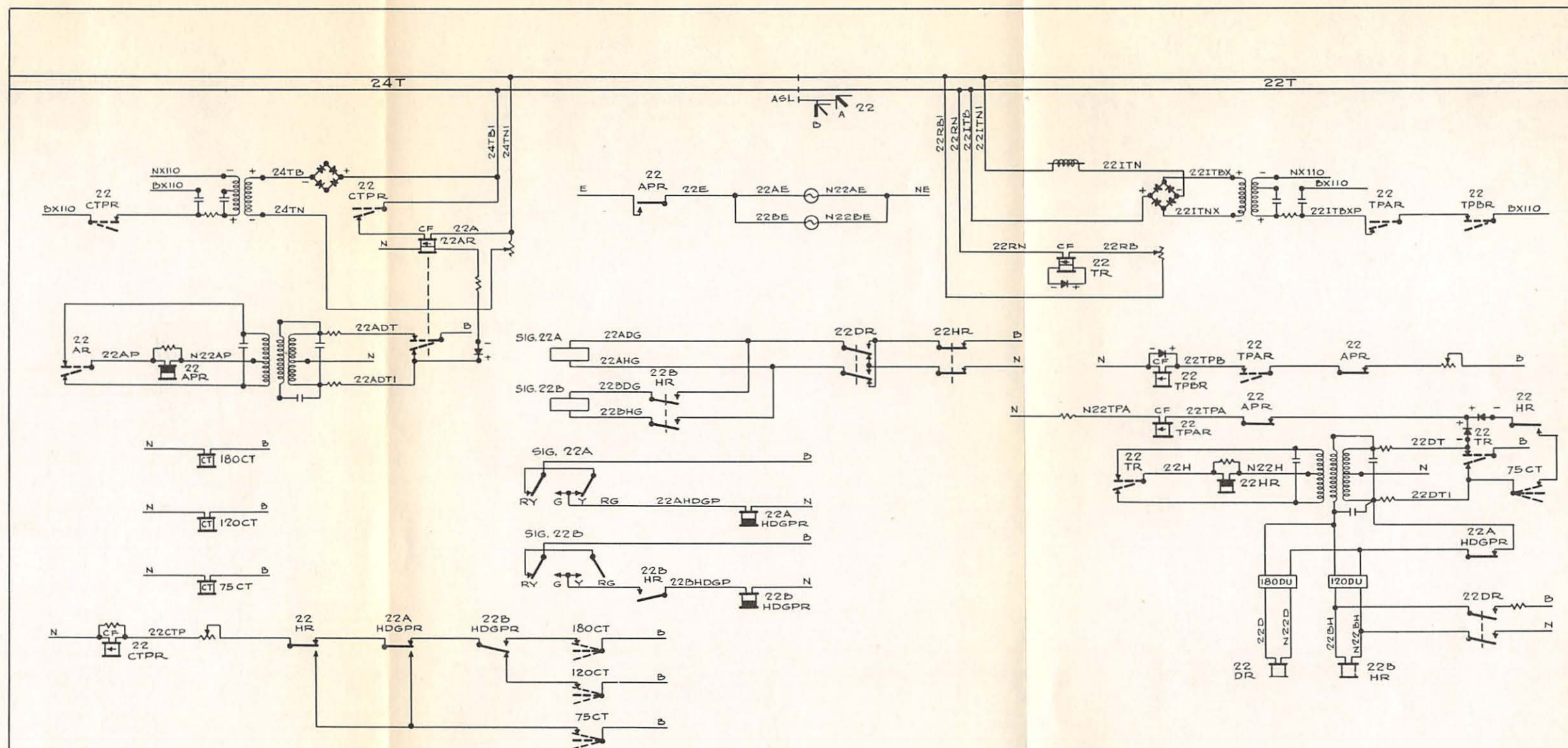


TYPICAL CODED TRACK CIRCUITS
FOR FOUR ASPECT AUTOMATIC SEARCHLIGHT SIGNALS
RECTIFIED AC OPERATION
TRACK SIGNALLED IN ONE DIRECTION
(CODE RULES 281-282A-285-291)

1. SHEET 1 PROVIDES TYPICAL AUTOMATIC SIGNAL CIRCUITS WITH REVERSE CODE FOR APPROACH LIGHTING.
2. SHEETS 2, 3, AND 4 PROVIDE TYPICAL AUTOMATIC SIGNAL CIRCUITS APPROACHING INTERLOCKING WITH REVERSE (INVERSE) CODE FOR APPROACH LOCKING AND OTHER REQUIRED FUNCTIONS.



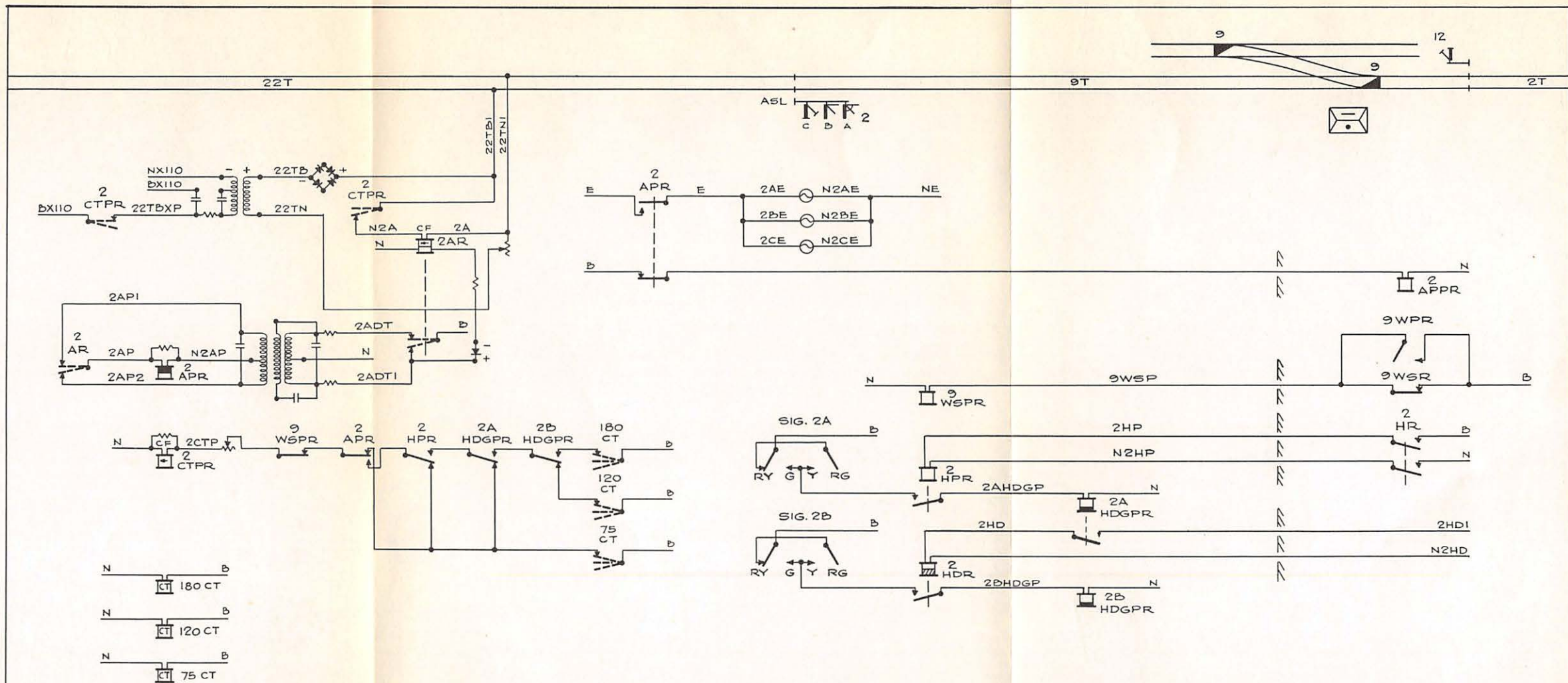
TYPICAL CODED TRACK CIRCUITS
FOR FOUR ASPECT AUTOMATIC SEARCHLIGHT SIGNALS
RECTIFIED AC OPERATION
TRACK SIGNALLED IN ONE DIRECTION
(CODE RULES 281-282A-285-291)



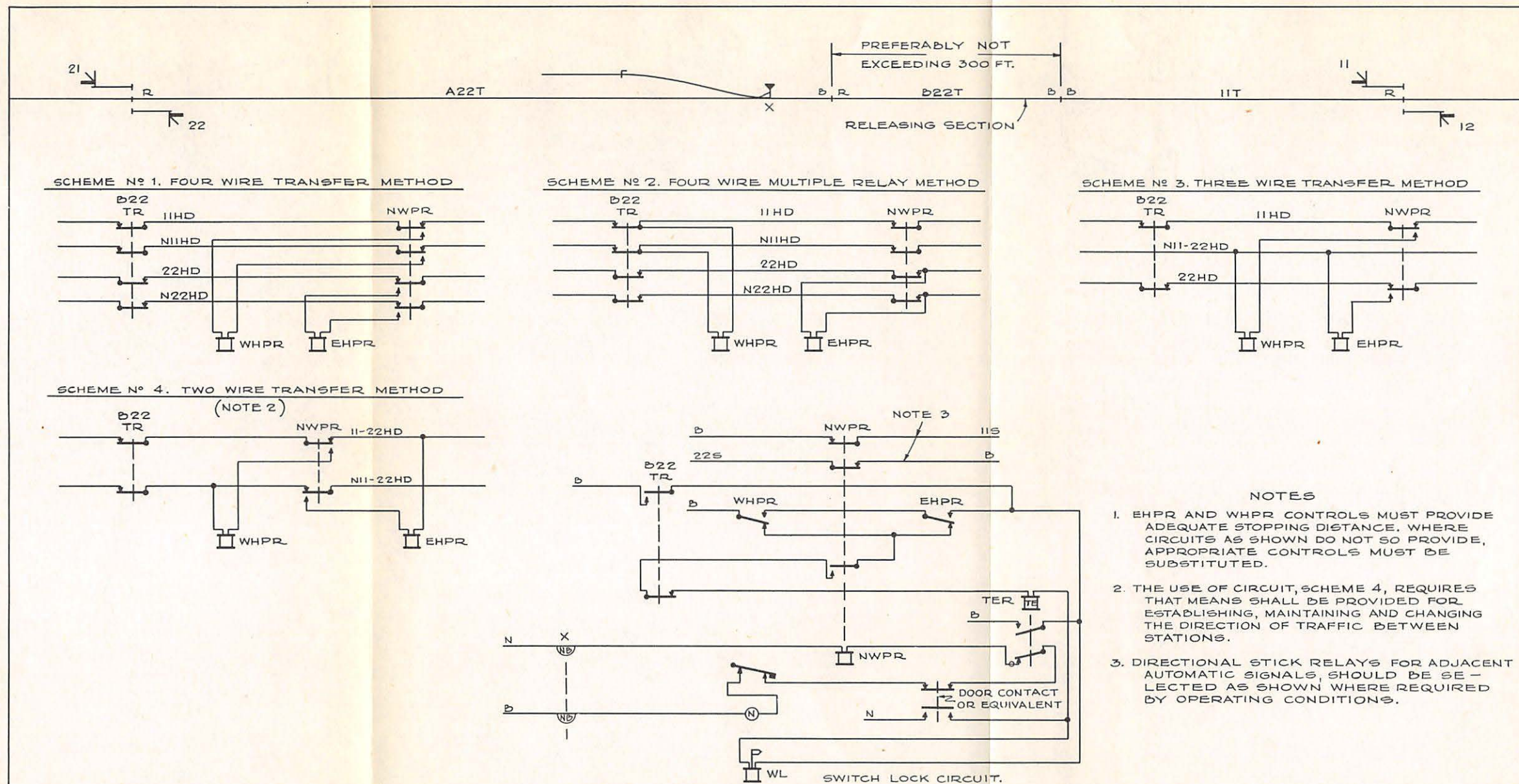
TYPICAL CODED TRACK CIRCUITS
FOR FOUR ASPECT AUTOMATIC SEARCHLIGHT SIGNALS
RECTIFIED AC OPERATION
TRACK SIGNALLED IN ONE DIRECTION
(CODE RULES 281-282A-285-291)

AAR
SIG. SEC
8047A

SEPT. 1950

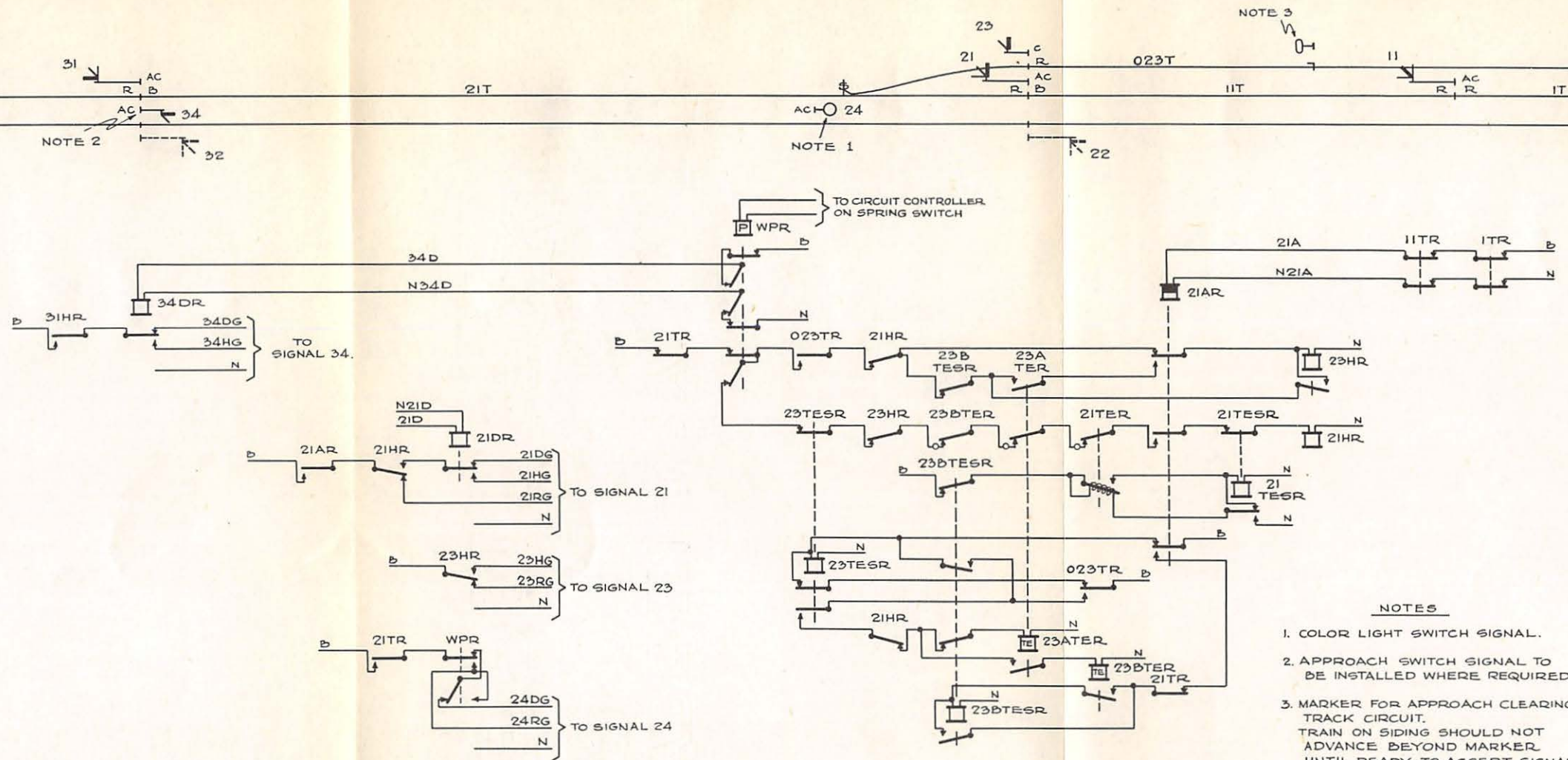


TYPICAL CODED TRACK CIRCUITS
FOR FOUR ASPECT AUTOMATIC SEARCHLIGHT SIGNALS
RECTIFIED AC OPERATION
TRACK SIGNALLED IN ONE DIRECTION
(CODE RULES 281-282A - 285 - 291.)

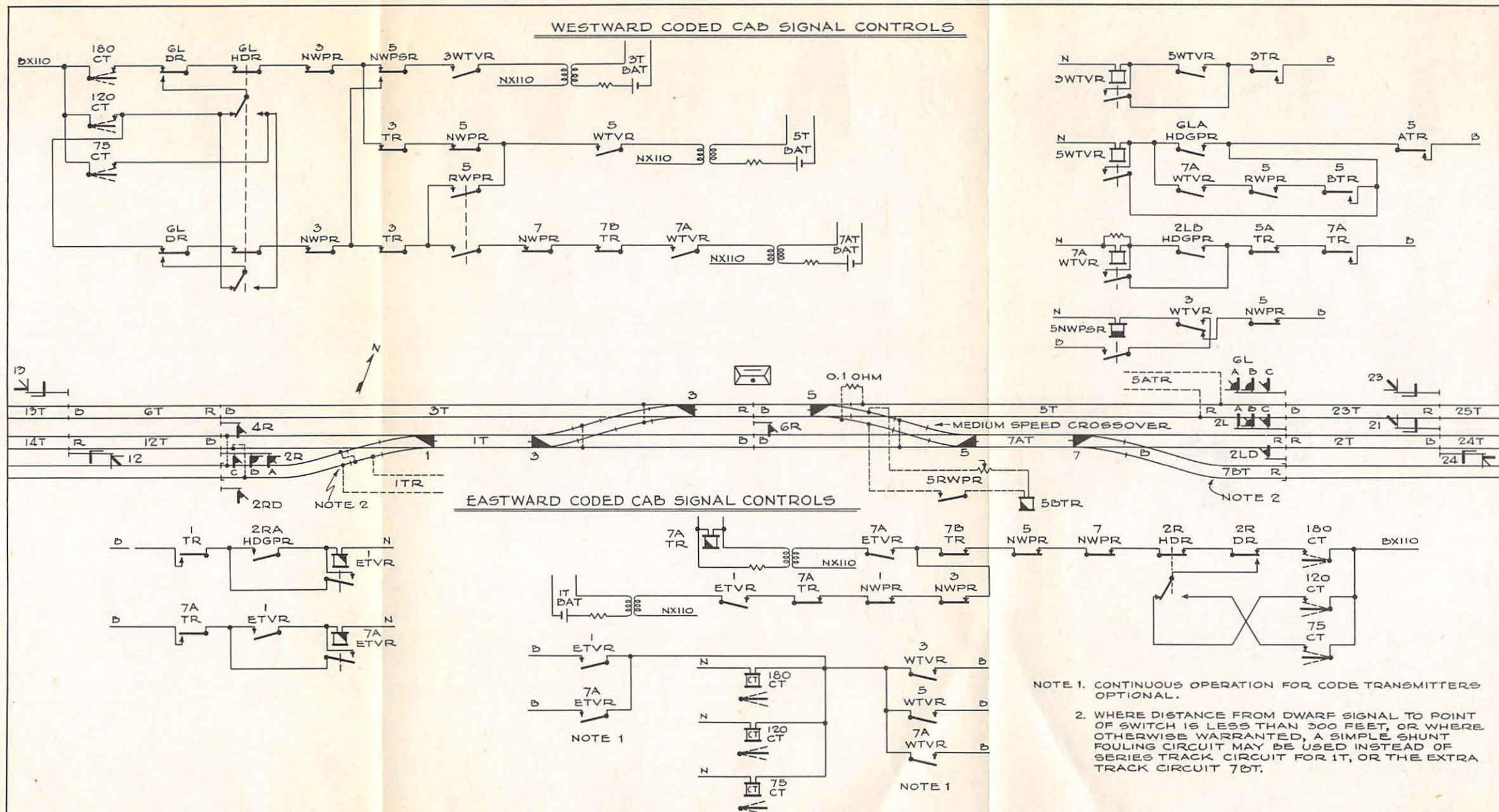


TYPICAL ELECTRIC SWITCH LOCK CIRCUITS
TIME AND APPROACH LOCKING WITH RELEASING TRACK SECTION
AUTOMATIC OPERATION
TRACK SIGNALLED IN BOTH DIRECTIONS

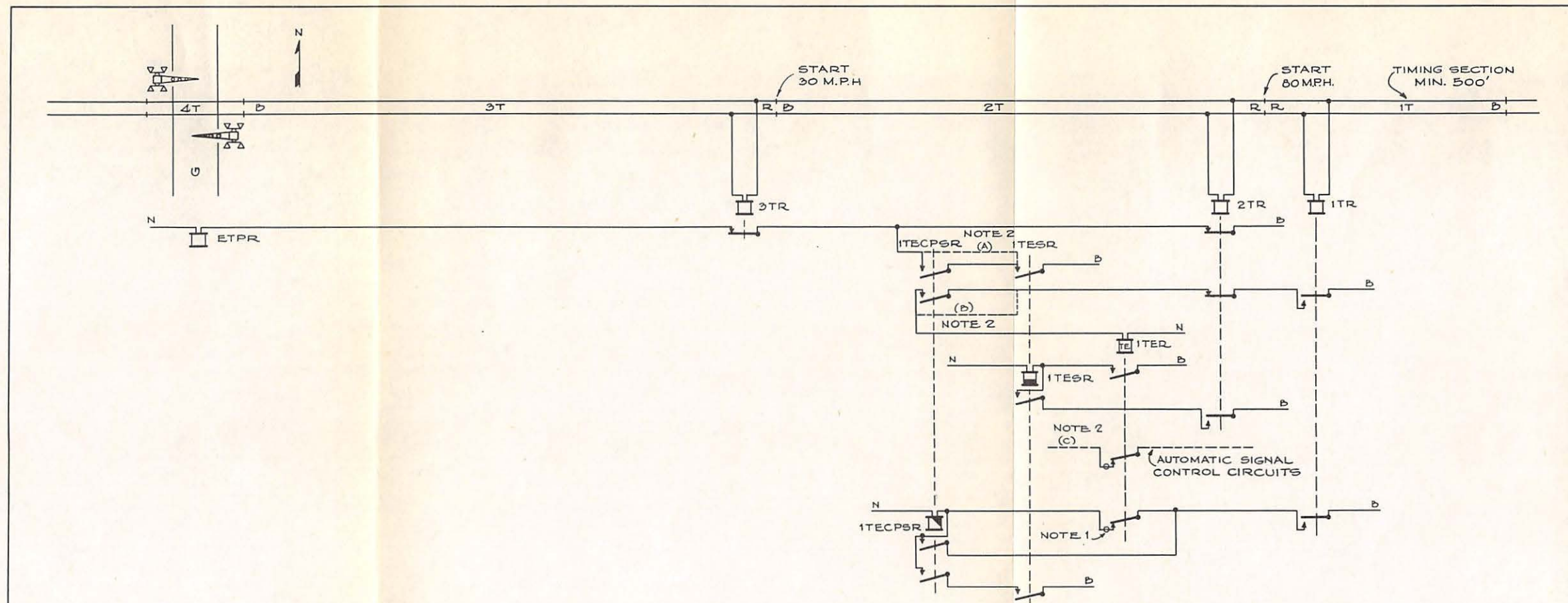




TYPICAL CIRCUITS FOR SPRING SWITCH AT END OF SIDING
TRACK SIGNALLED IN ONE DIRECTION
SIGNALS AT SWITCH APPROACH CLEARED — WITH APPROACH LOCKING.



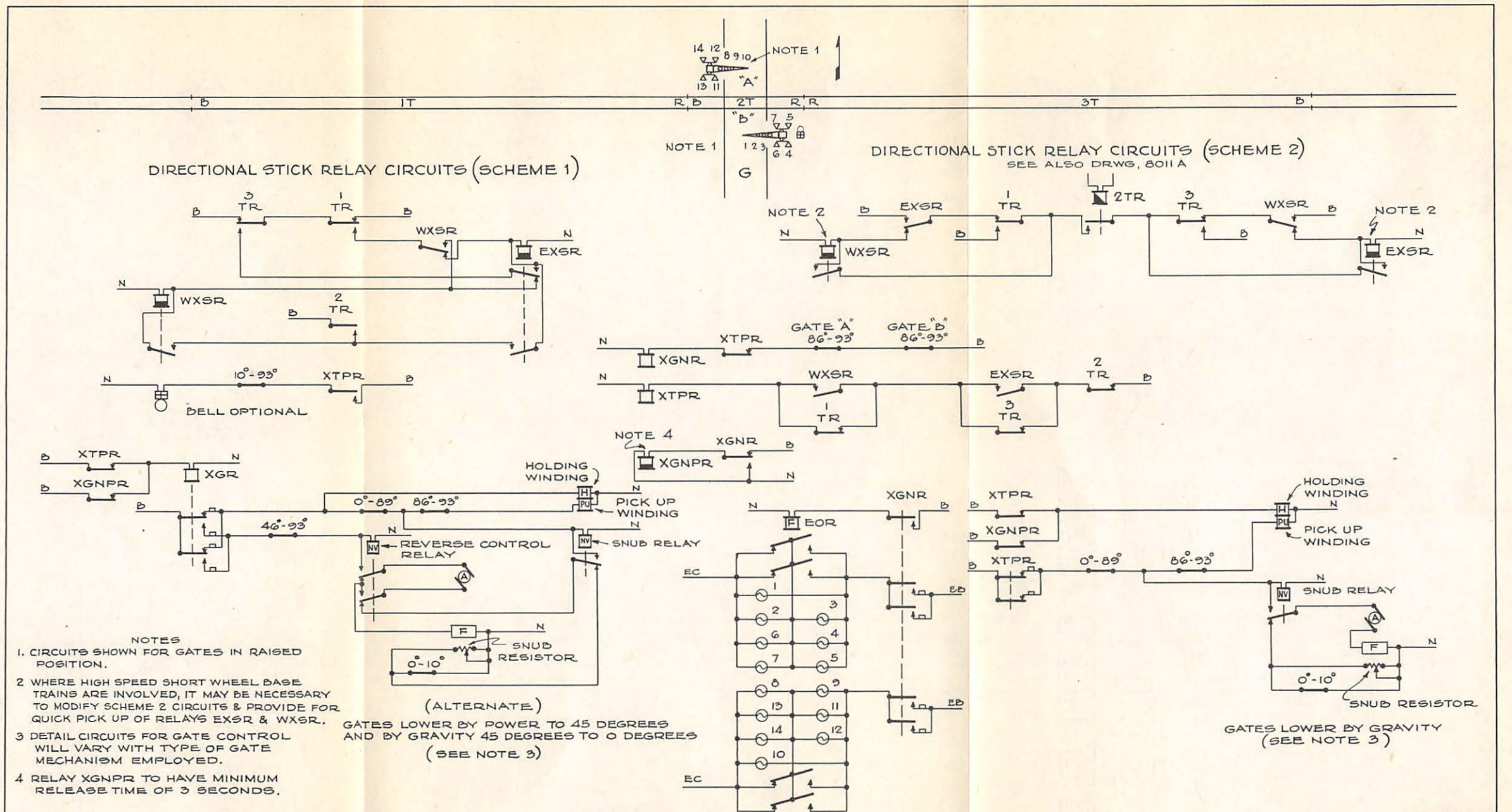
TYPICAL CIRCUITS TO SUPERIMPOSE FOUR INDICATION CODED CAB SIGNAL CONTROLS
ON DC TRACK CIRCUITS AT INTERLOCKING



NOTE 1. CHECKING CONTACT IN 1TER INSURES A COMPLETE TIMING CYCLE FOR FOLLOWING TRAINS.

NOTE 2. IF CHECK REFERRED TO IN NOTE 1 IS NOT REQUIRED, USE CONNECTIONS (A) AND (B), AND CHECK CONTACT SELECTION (C) AND OMIT RELAY 1TECPSR.

TYPICAL CIRCUITS FOR SELECTIVE SPEED CONTROLS
 AUTOMATIC HIGHWAY CROSSING SIGNAL PROTECTION



TYPICAL CIRCUITS FOR AUTOMATIC HIGHWAY CROSSING GATES

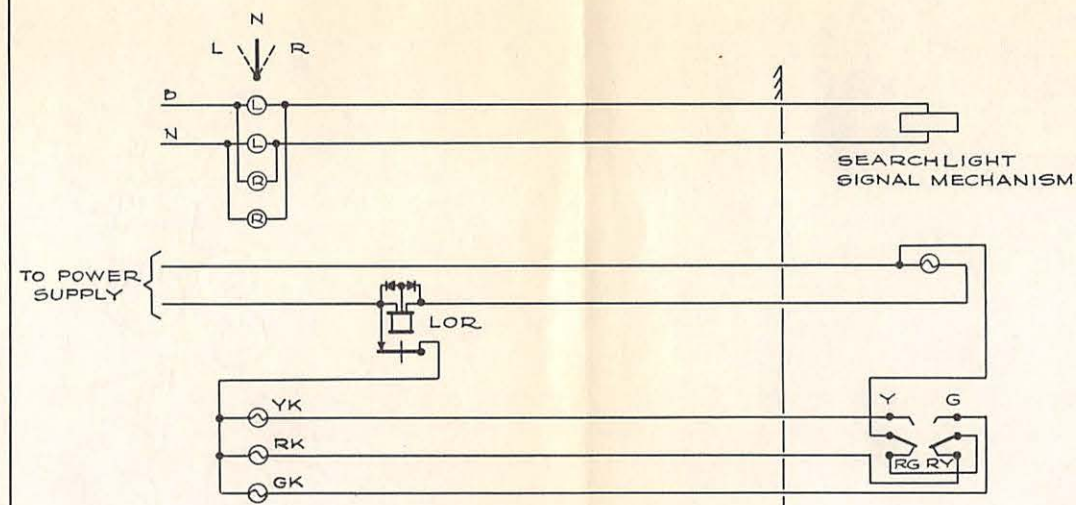


FIG. 1 - SEARCHLIGHT TYPE

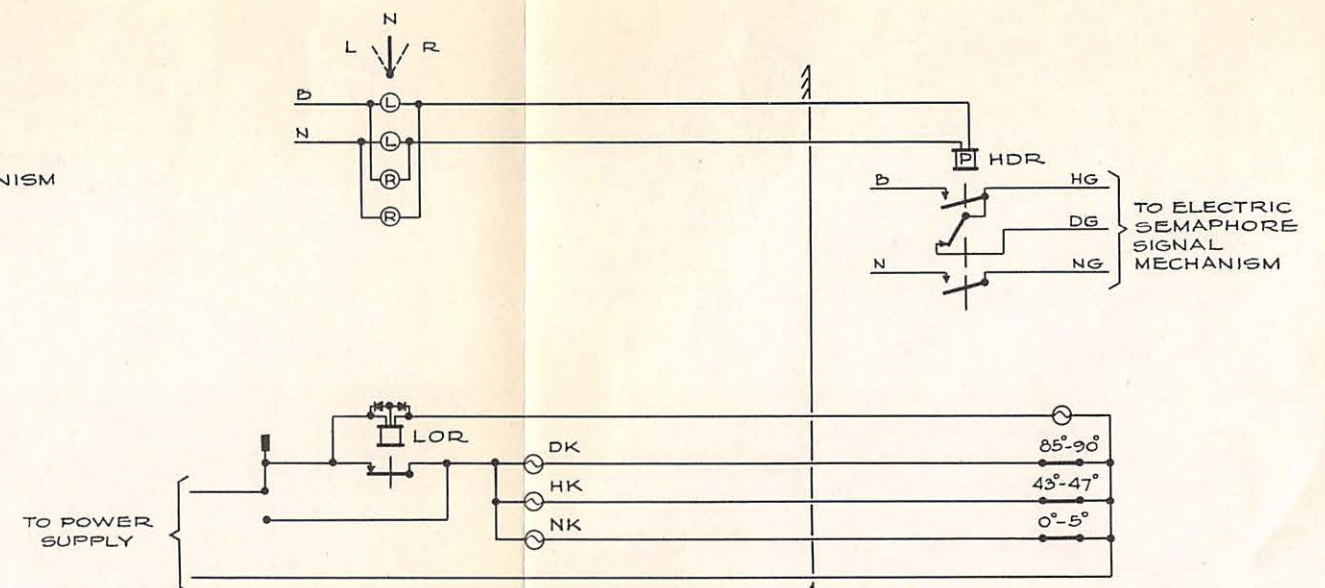


FIG. 3 - ELECTRIC SEMAPHORE SIGNAL

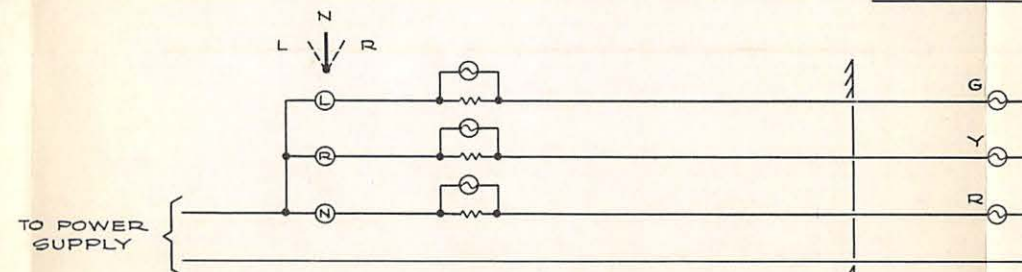


FIG. 2 - UNIT LIGHT TYPE

TYPICAL CIRCUITS FOR ELECTRIC SEMAPHORE AND COLORLIGHT TRAIN ORDER SIGNALS